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Mizuno et al.

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(54) **IMAGING CARTRIDGE AND IMAGE FORMING APPARATUS**

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(22) Filed: **Aug. 25, 2008**

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(51) **Int. Cl.**
G03G 15/08 (2006.01)

(52) **U.S. Cl.** **399/120**

(58) **Field of Classification Search** 399/111–114, 399/120, 103, 106
See application file for complete search history.

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(57) **ABSTRACT**

An imaging cartridge has a process unit and a toner box unit formed by integrating a new toner box and a waste toner box. The toner box unit is attachable to and detachable from the process unit. Shutters which open and close a connecting section between the new toner box and a developing device included in the process unit can be opened by manual operation when the toner box unit is attached to the process unit. Shutters and which open and close a connecting section between a cleaning device included in the process unit and the waste toner box are opened when the imaging cartridge is in the process of being moved to a prescribed position in an apparatus body.

12 Claims, 14 Drawing Sheets

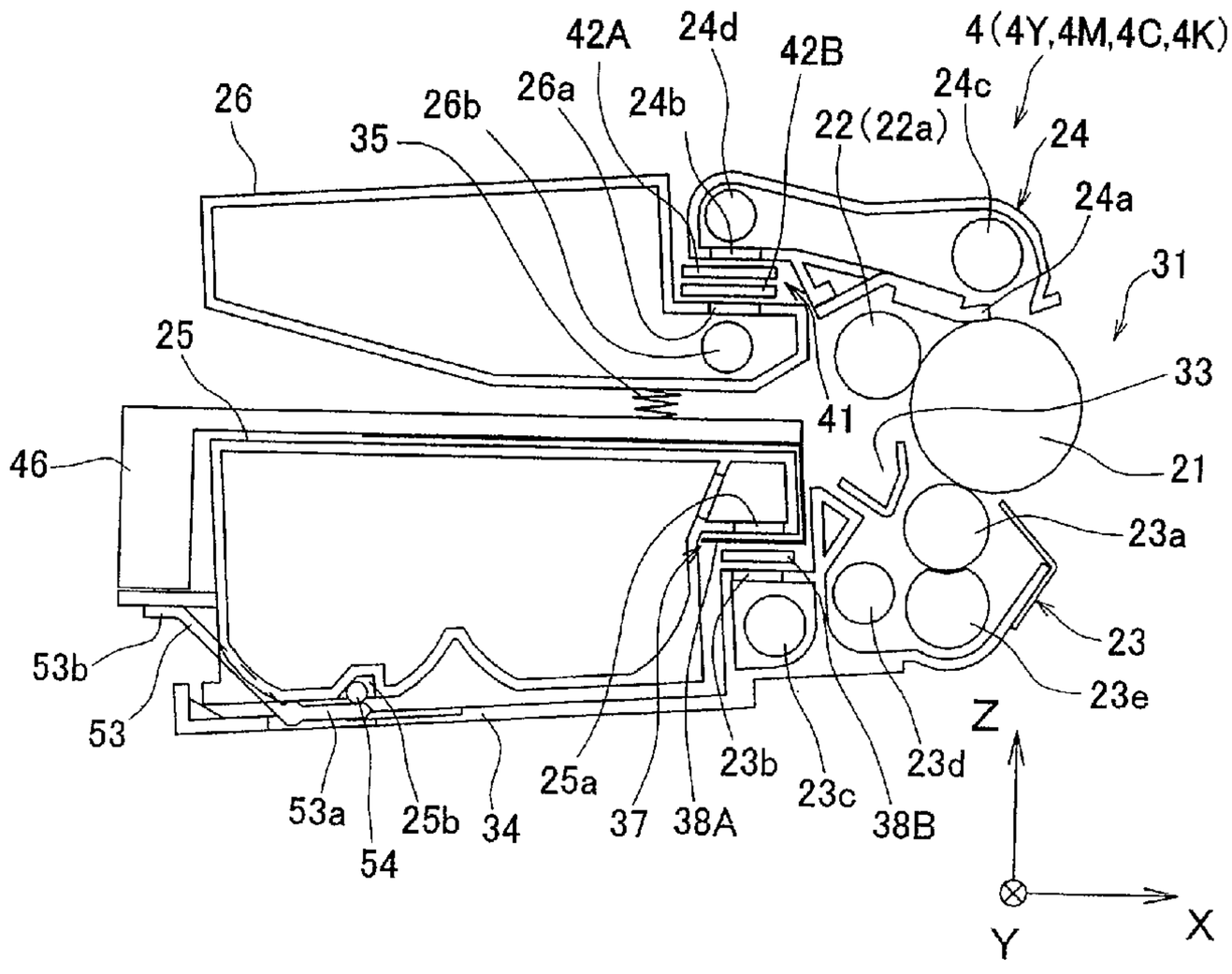
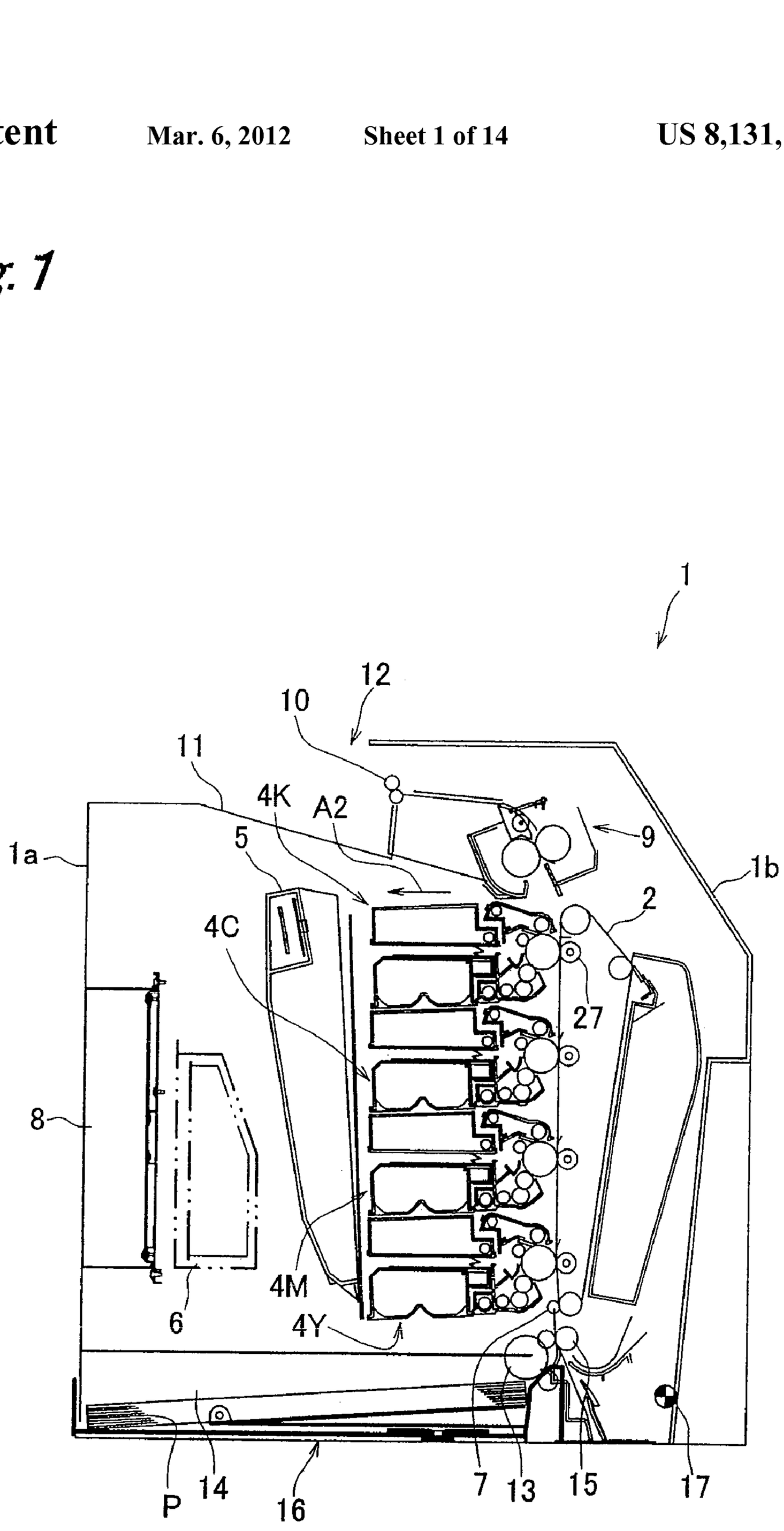


Fig. 1



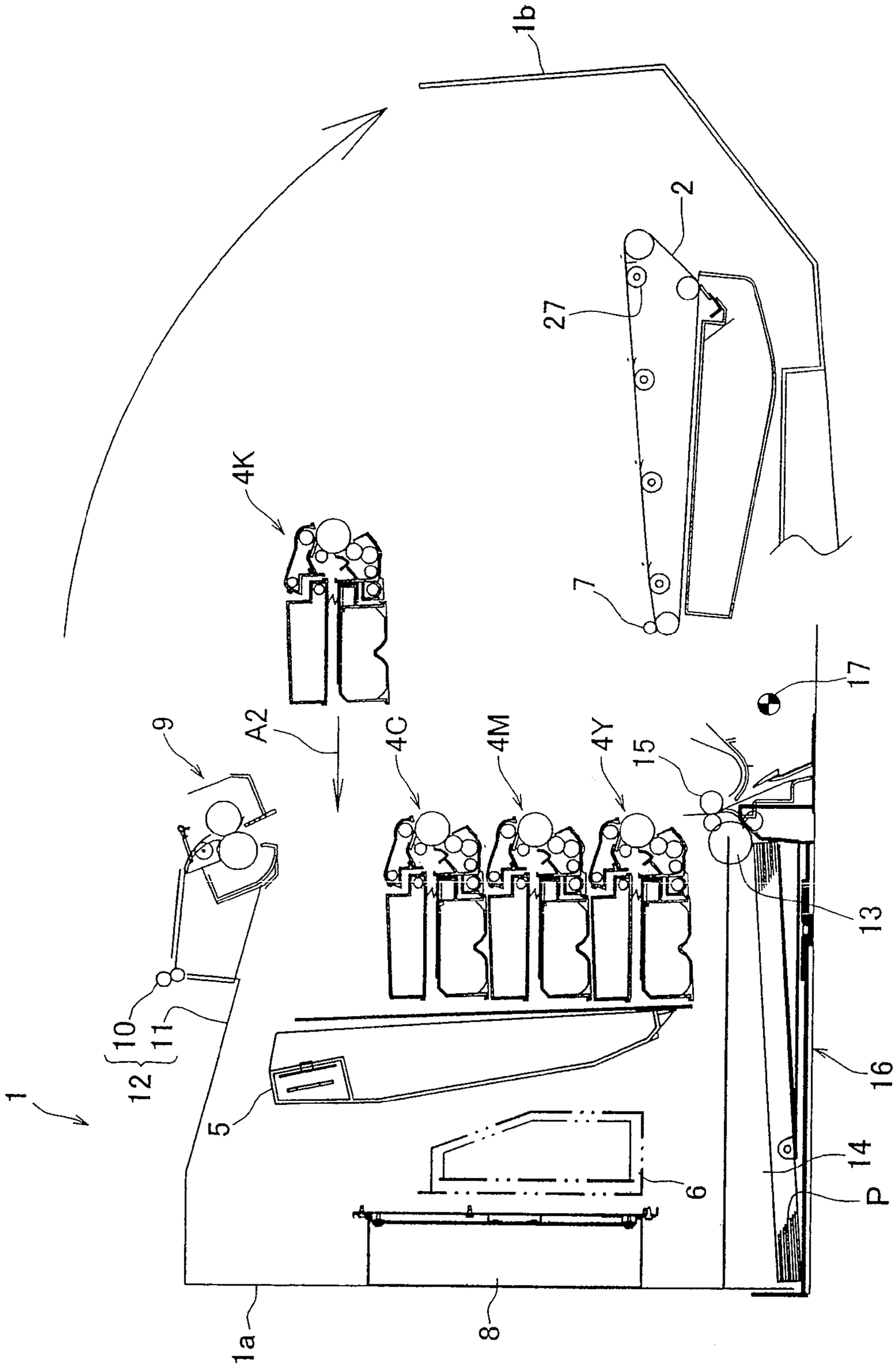


Fig.2

Fig.3

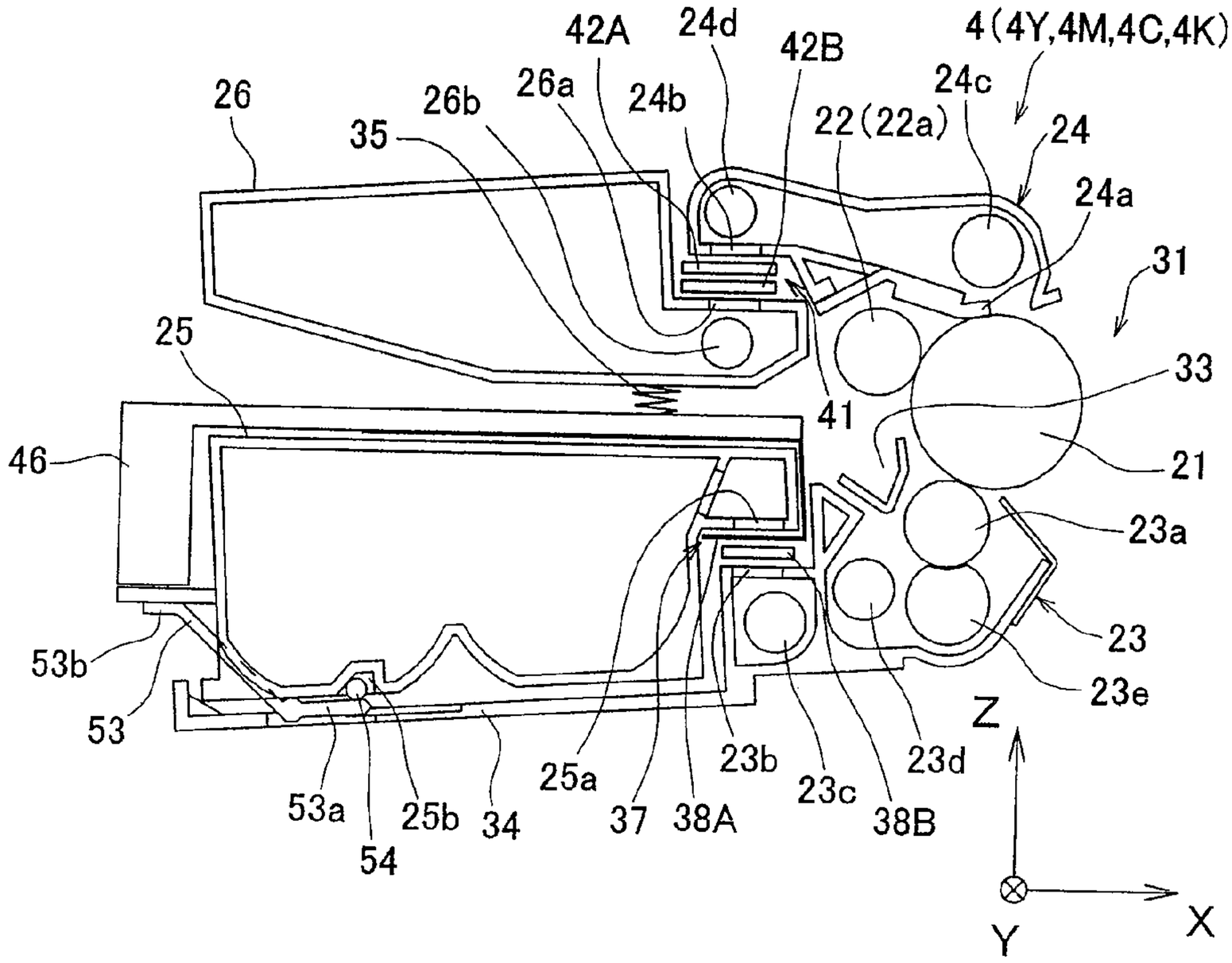
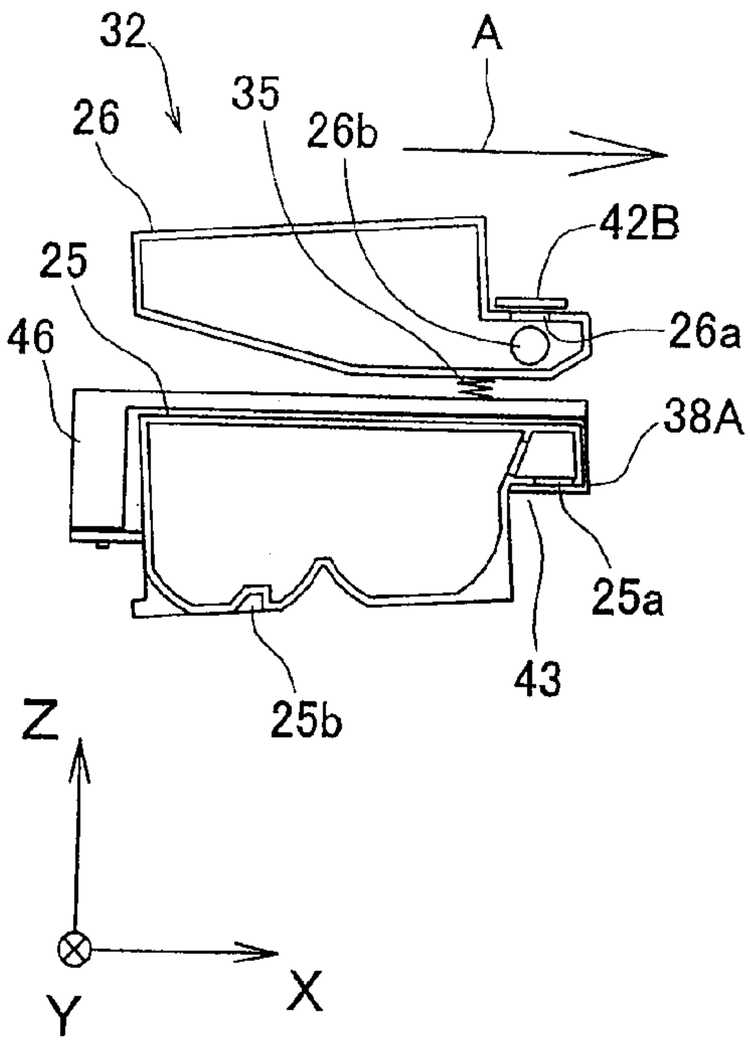

42A
24d
42B
4(4Y,4M,4C,4K)
26
26b
26a
24b
24c
35
22(22a)
24
24a
31
25
33
41
46
21
23a
53b
23
23e
53
Z
25a
23b
23d
53a
25b
34
37
38A
23c
38B
54
Y
X

Fig.4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35
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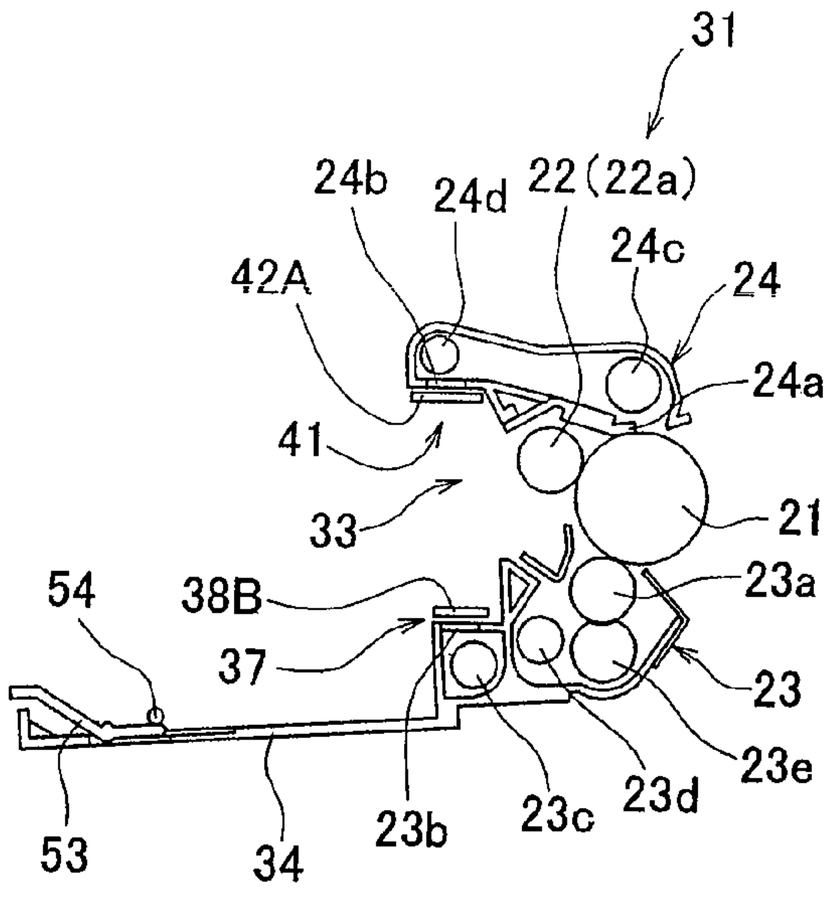
26a
46
38A
25a
43
25b
Z
Y
X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24b
24d
22(22a)
42A
24c
24
24a
41
33
21
54
38B
23a
37
23
23e
53
34
23b
23c
23d

Fig.5

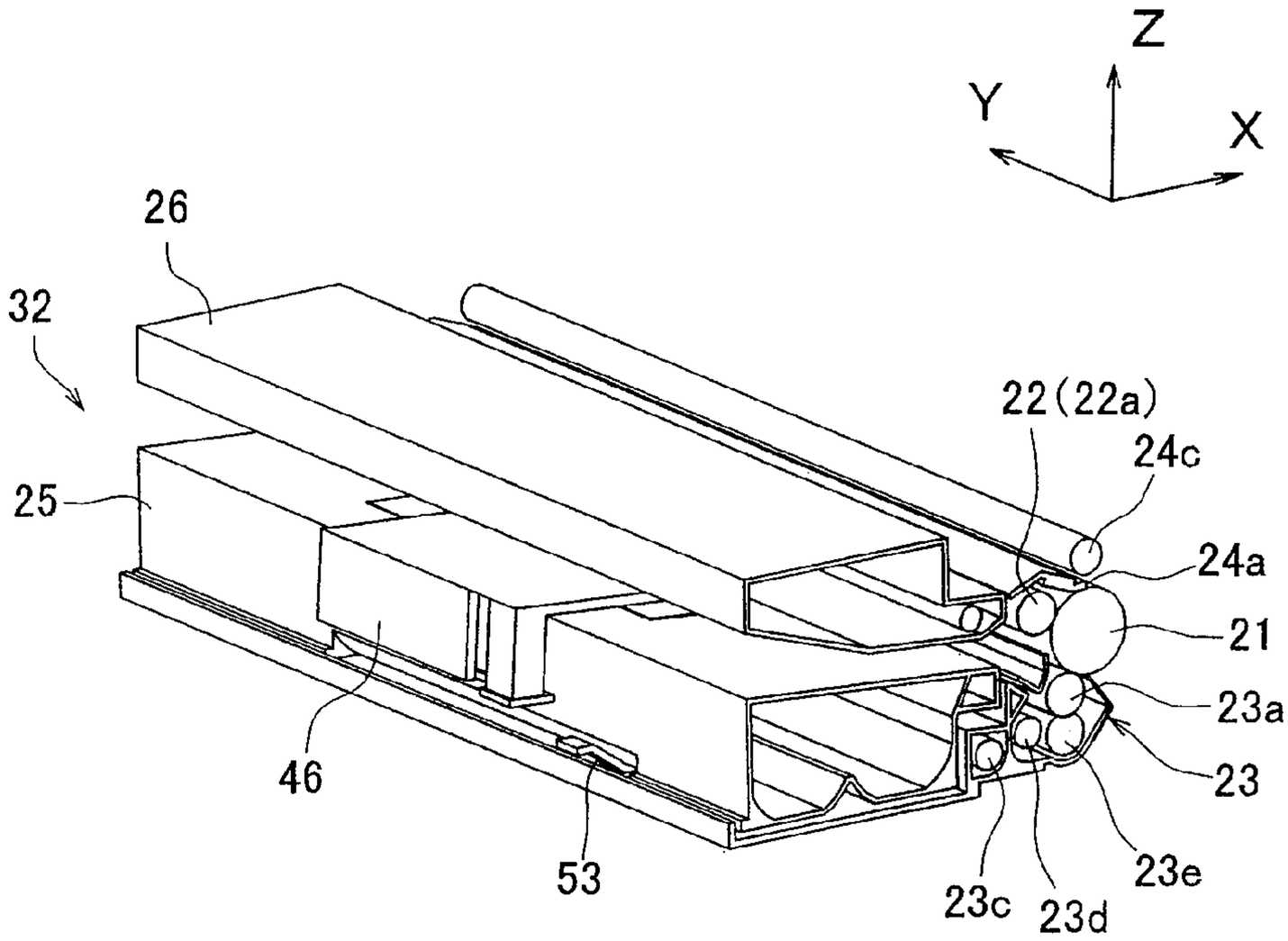

Z
Y
X
26
32
25
22(22a)
24c
24a
21
23a
23
23e
23c
23d
46
53

Fig.6

31
26
26a
33
24
25
24d
22(22a)
32
24c
21
23c
23
23e
26b
34
23b
23c
23d
Z
Y
X

Fig. 7A

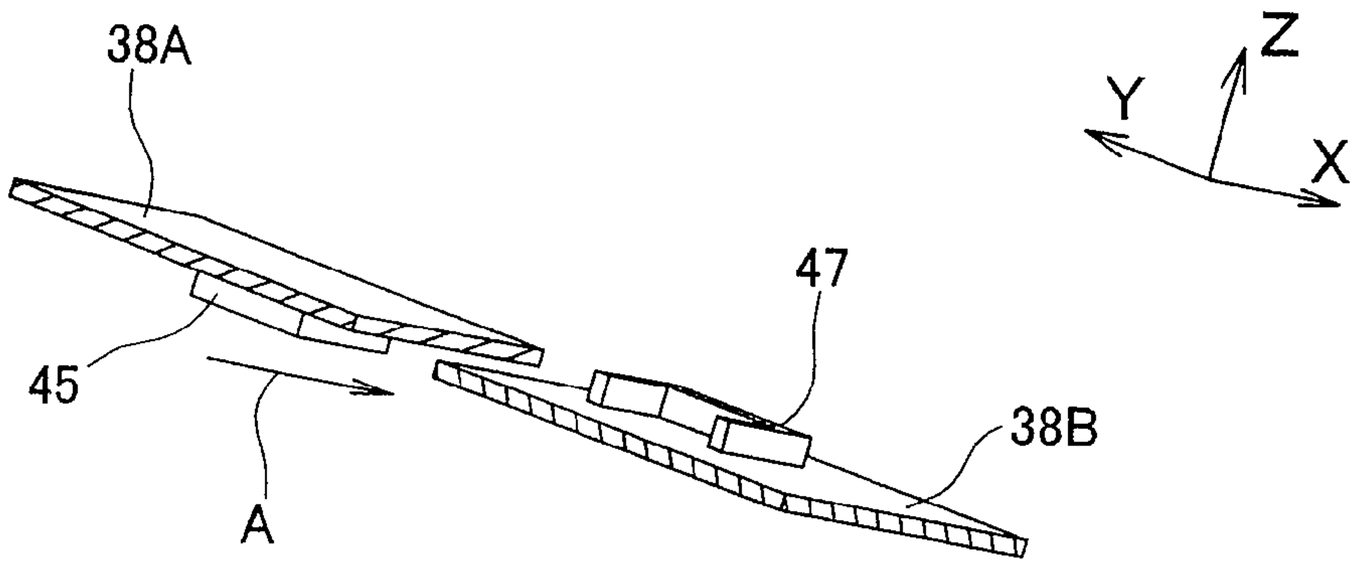


Fig. 7B

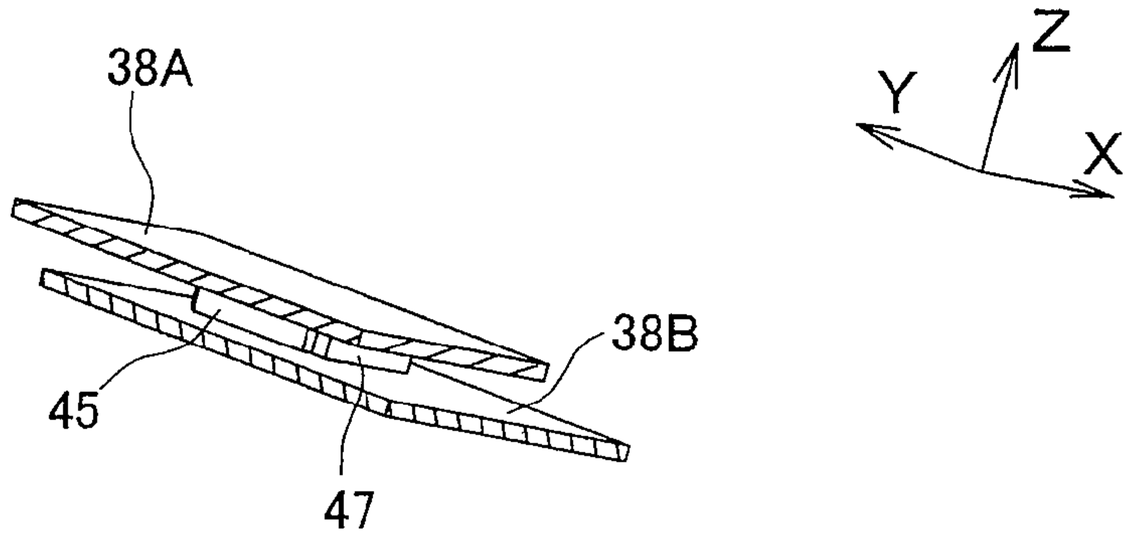


Fig.8

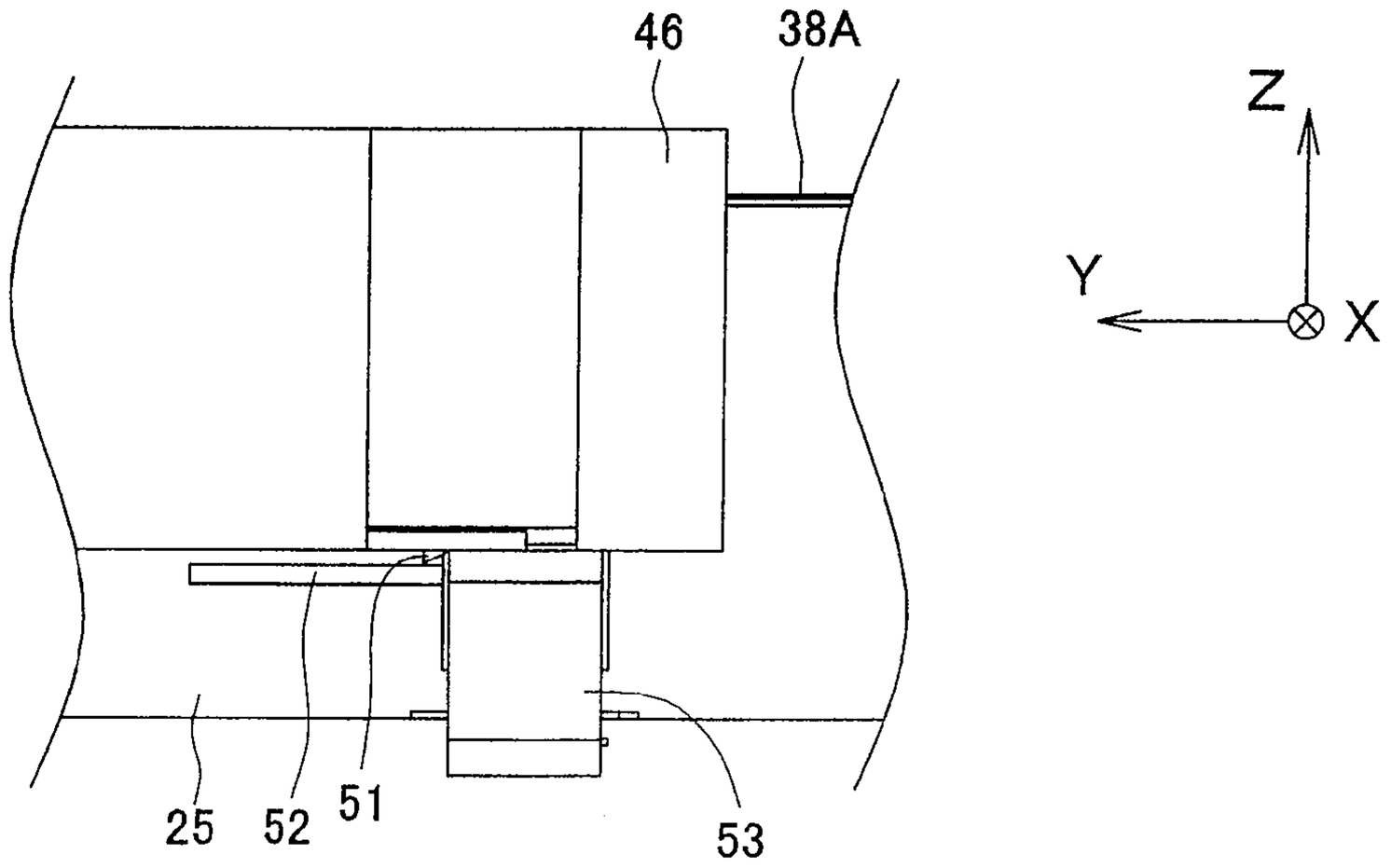


Fig.9

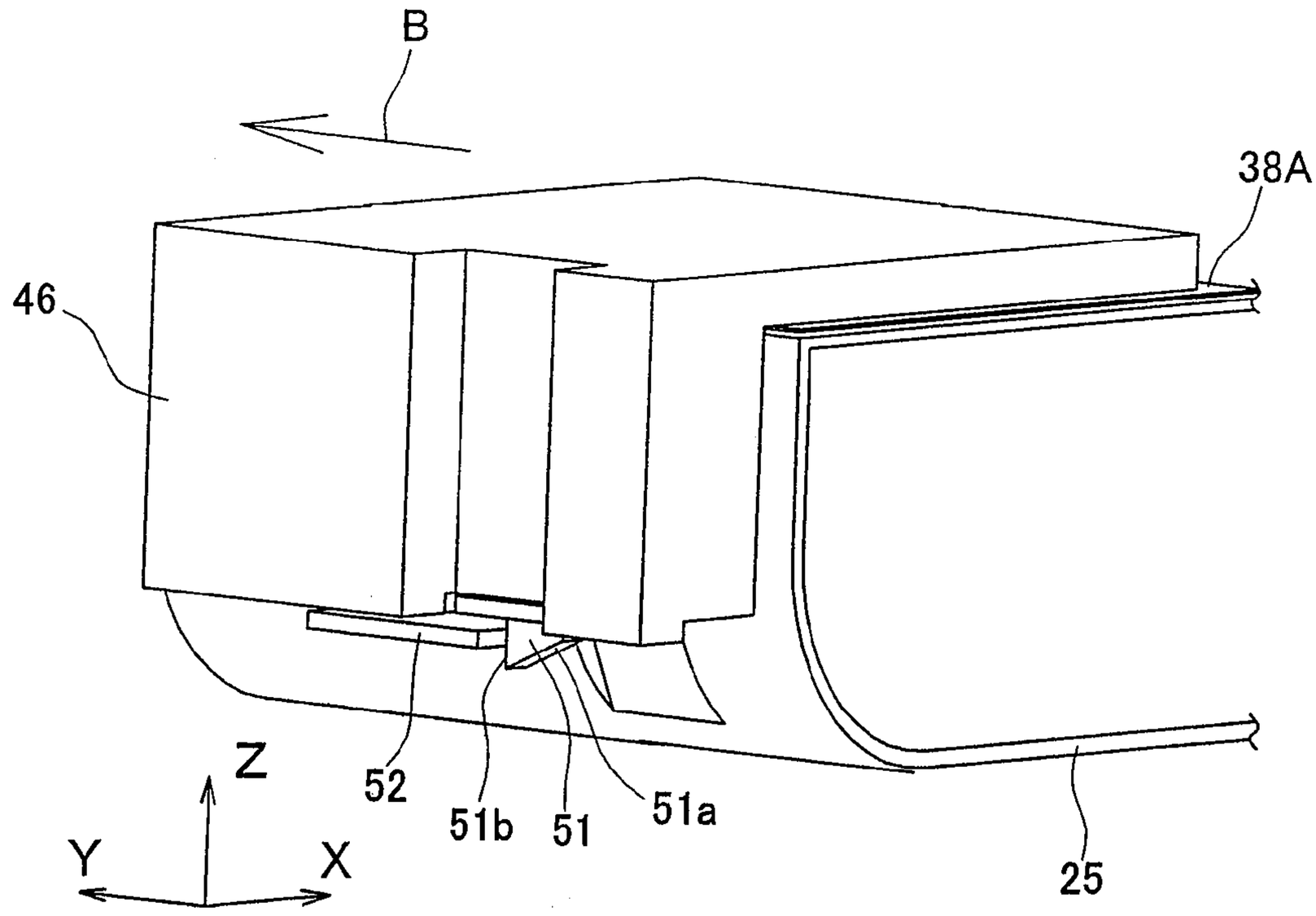


Fig. 10A

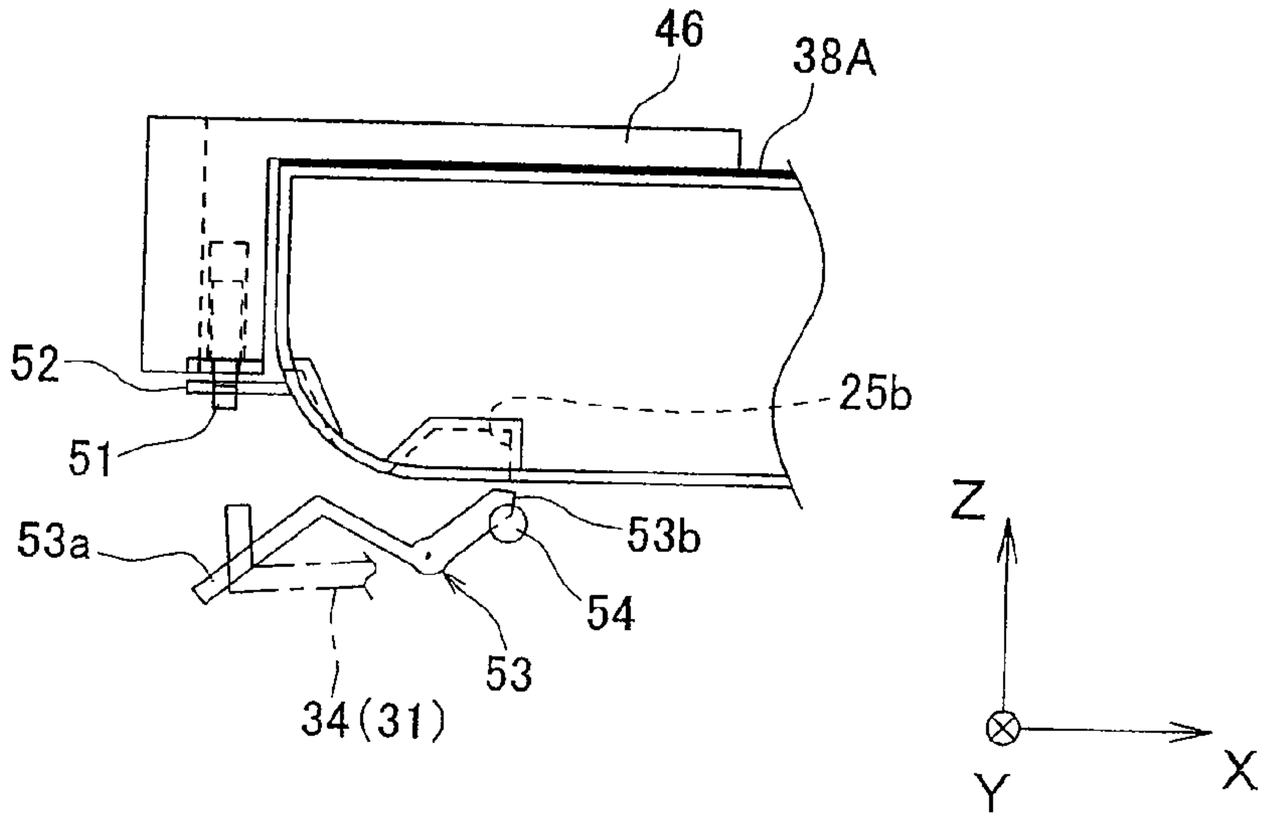


Fig. 10B

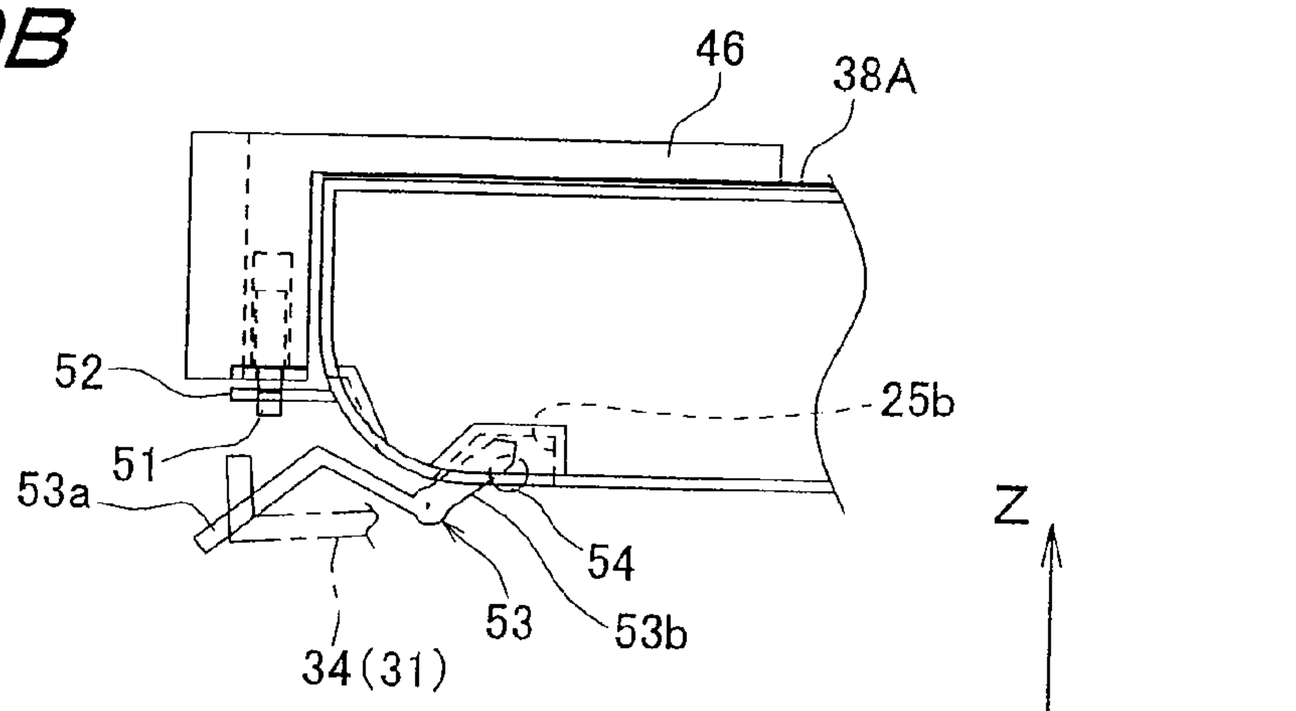


Fig. 10C

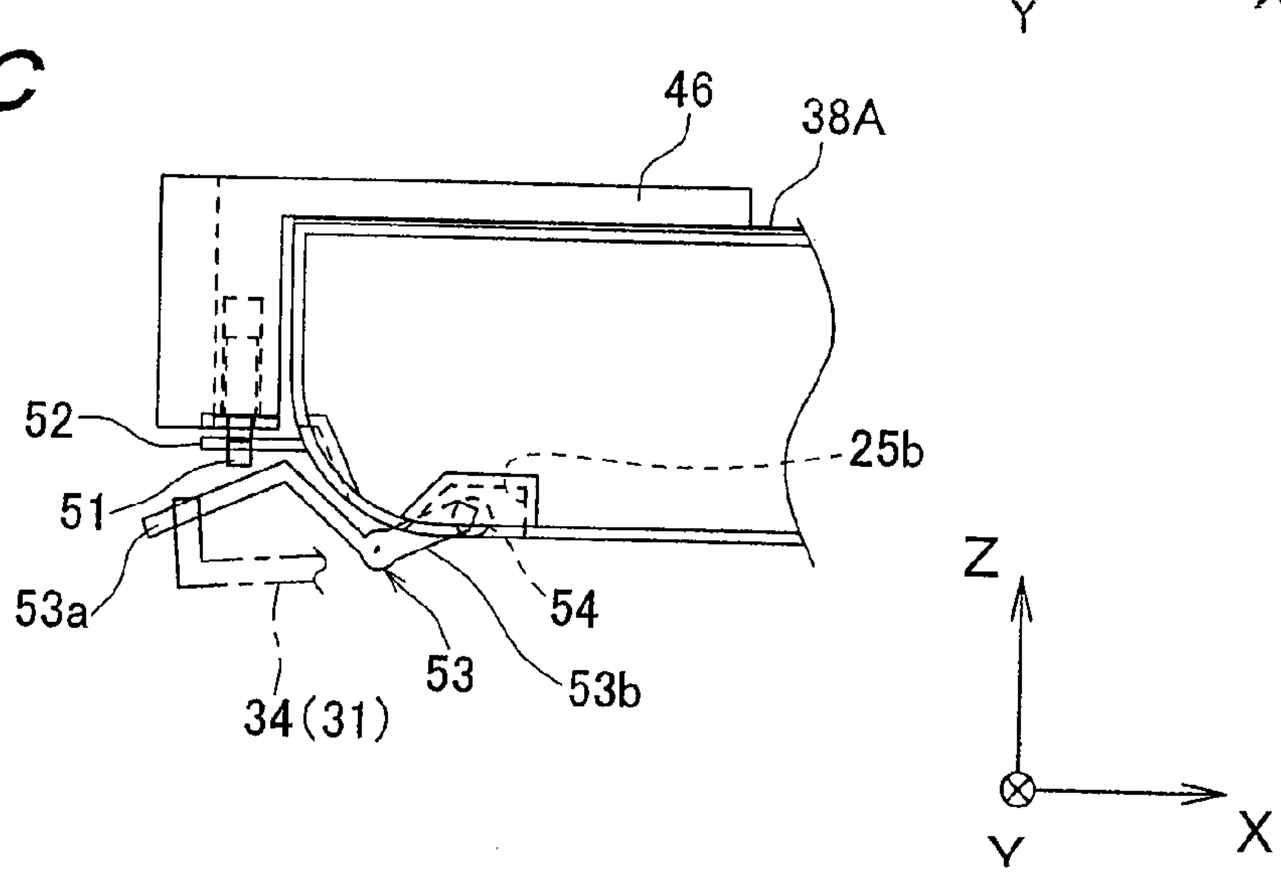


Fig. 10D

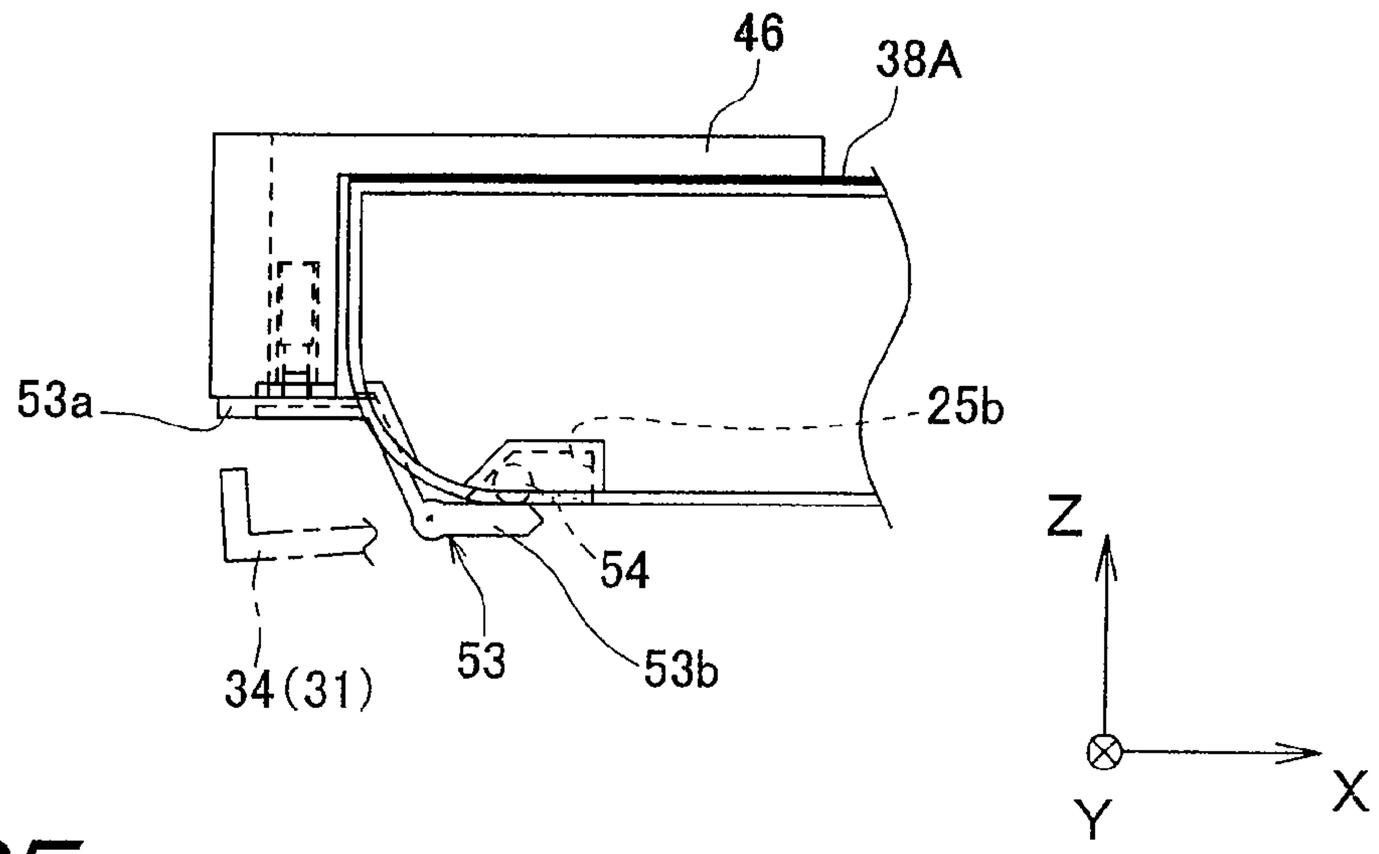


Fig. 10E

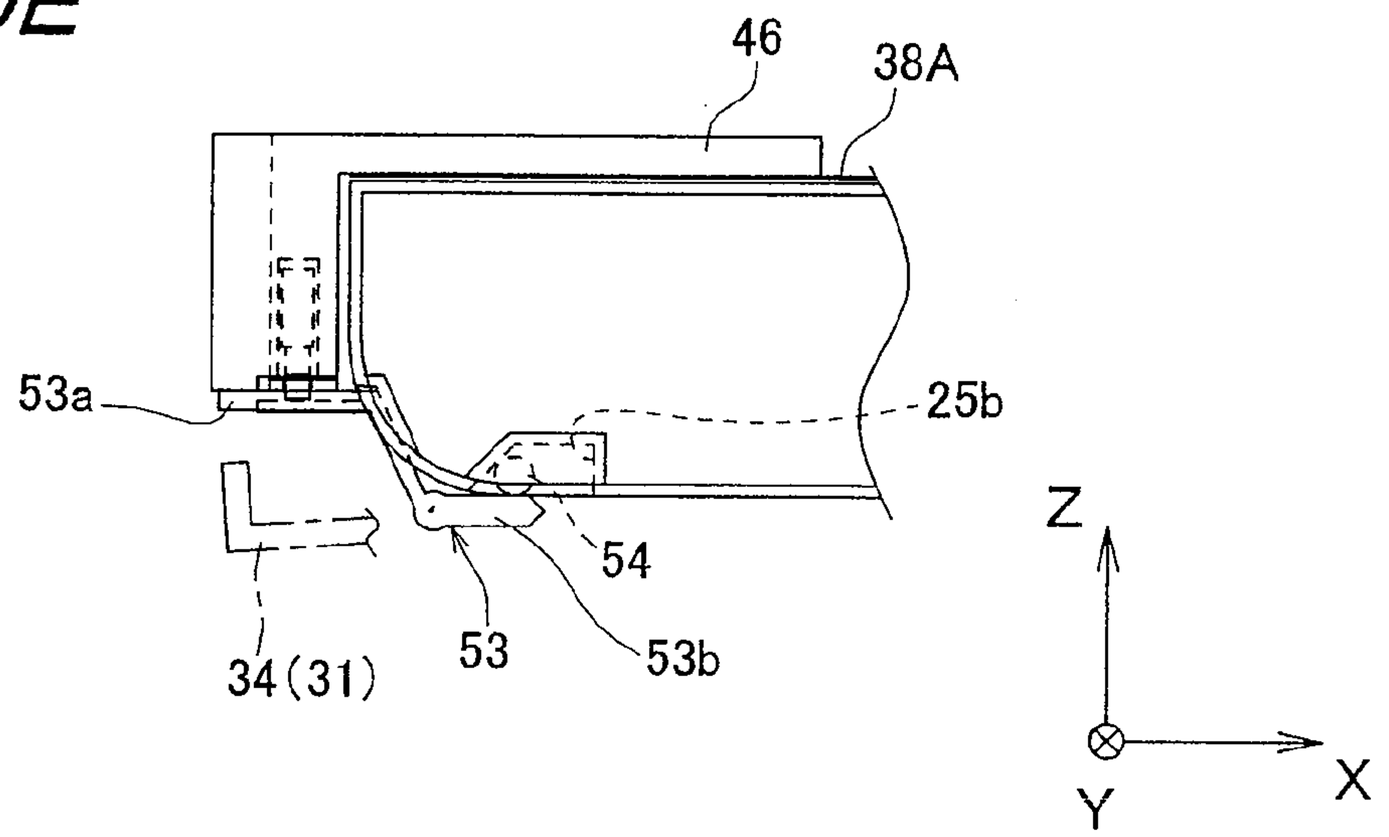


Fig. 11A

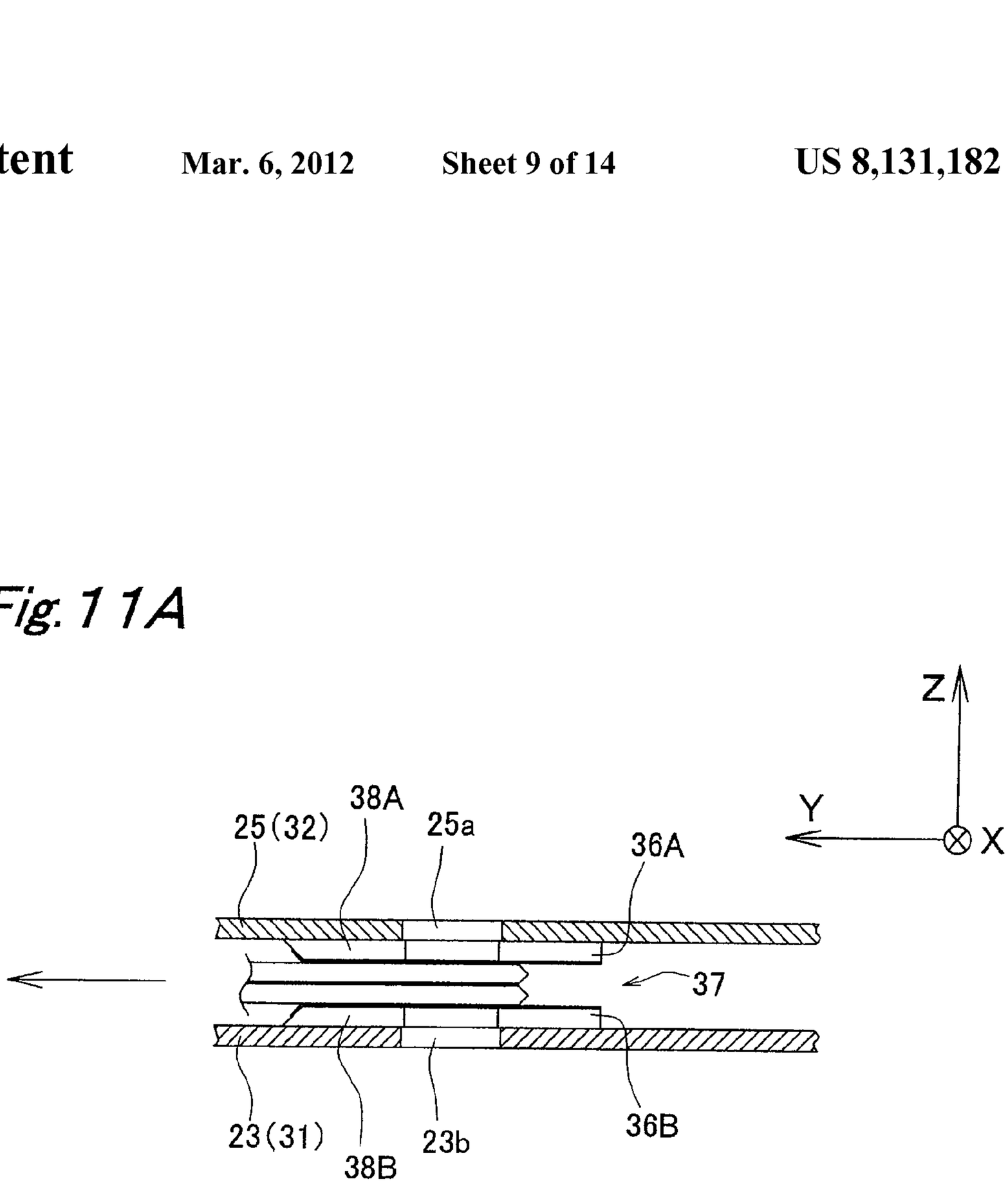


Fig. 11B

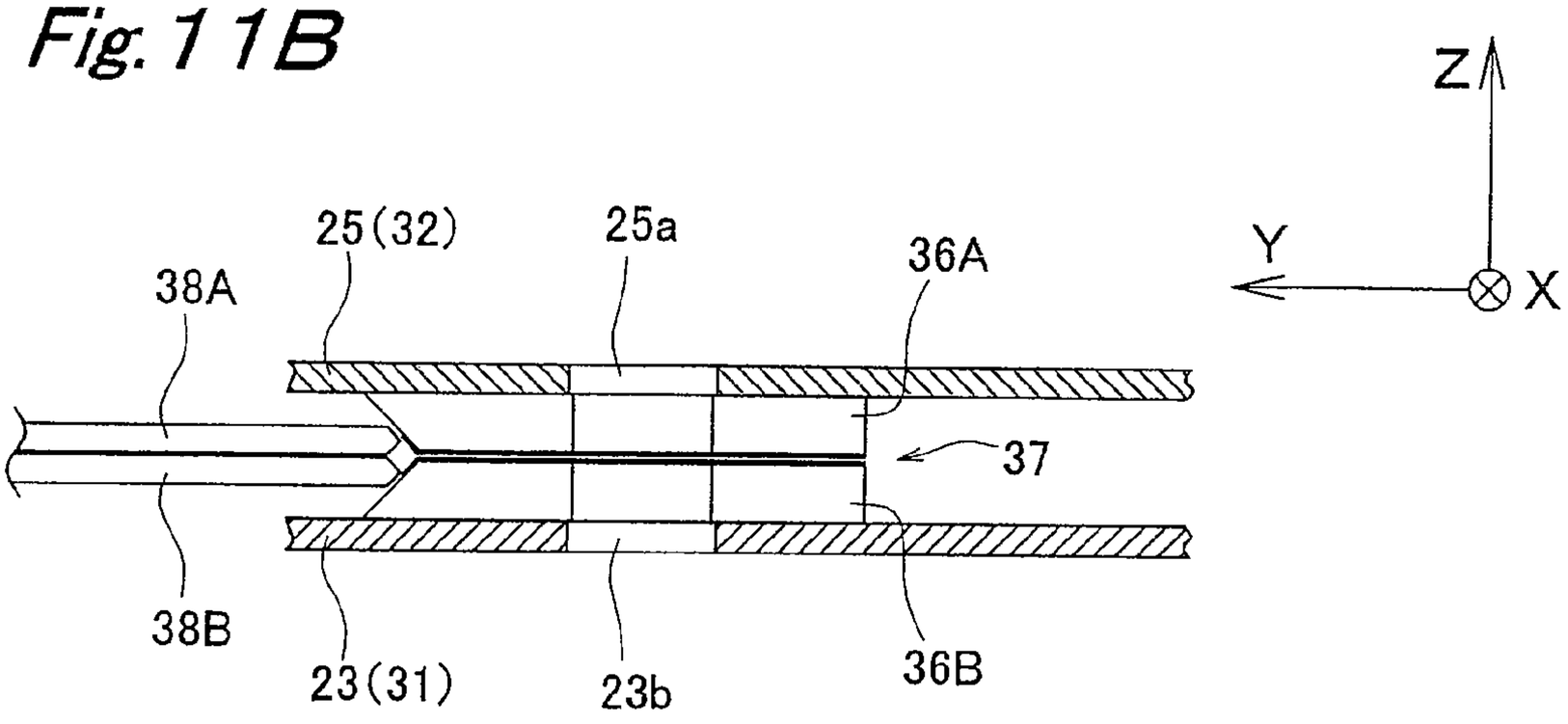


Fig. 12A

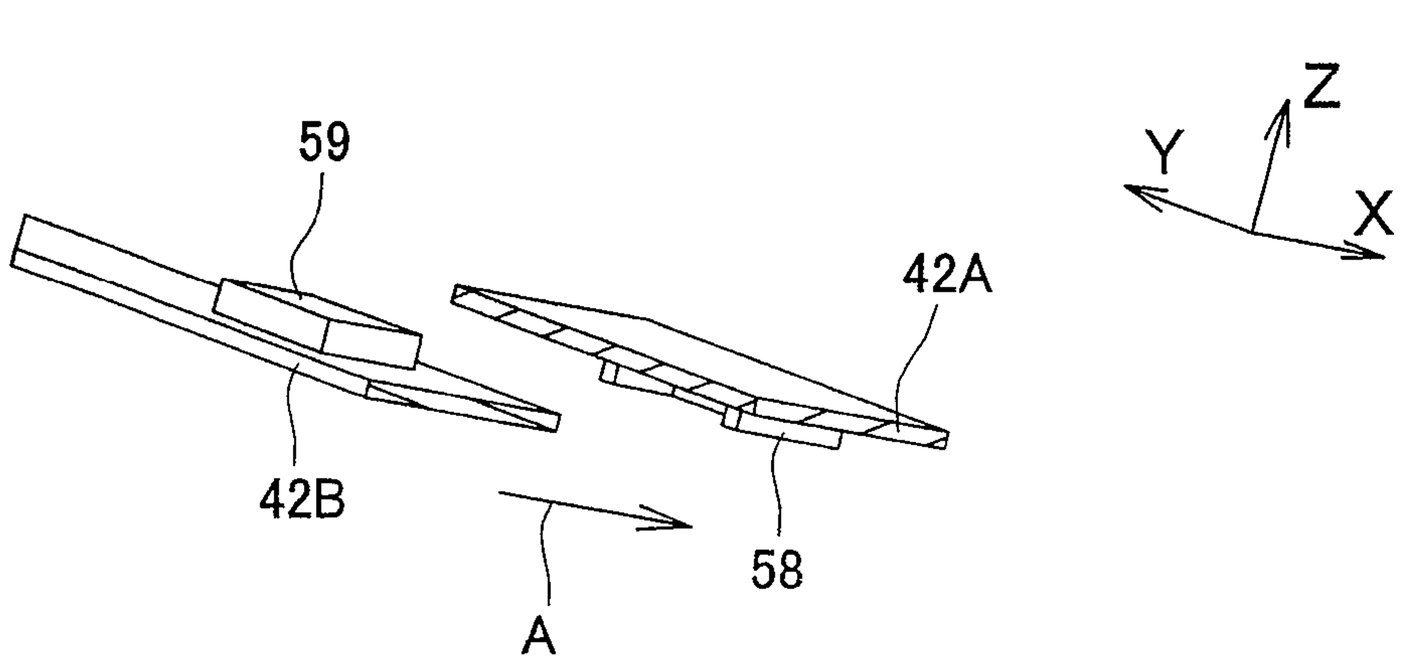


Fig. 12B

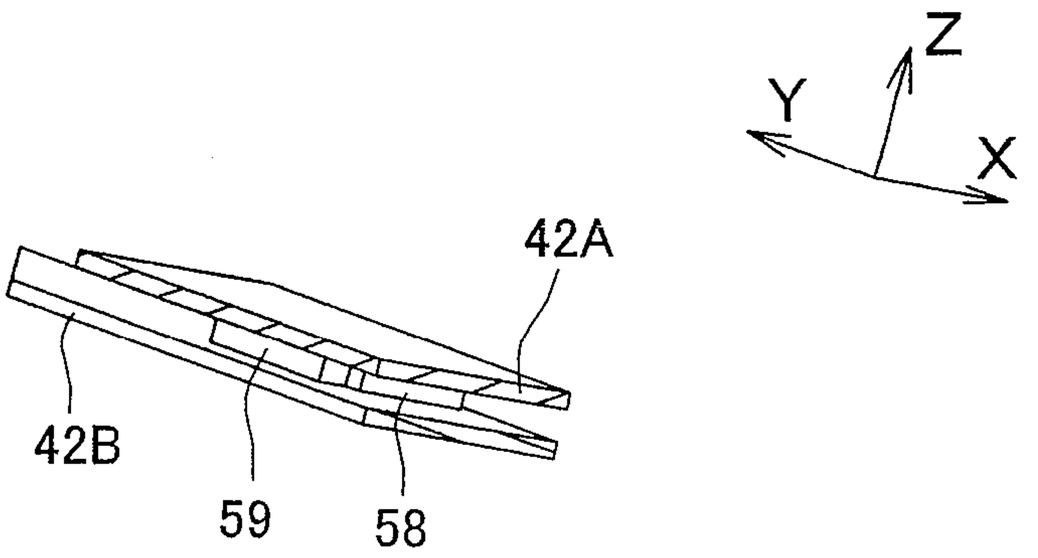
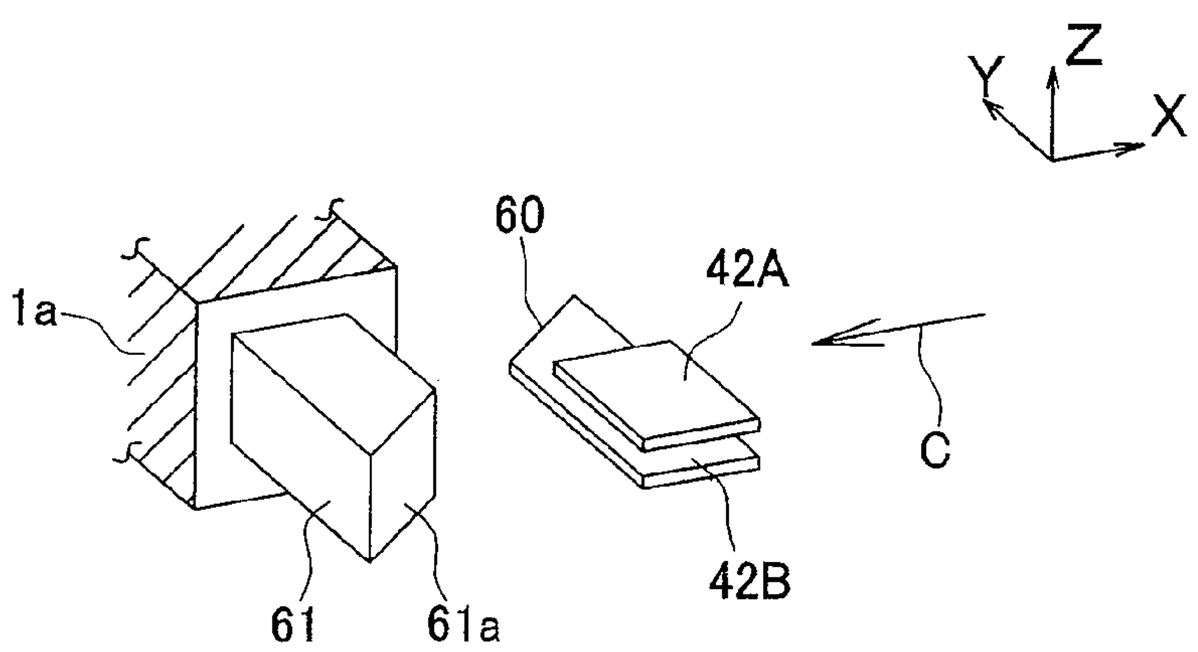


Fig. 13A



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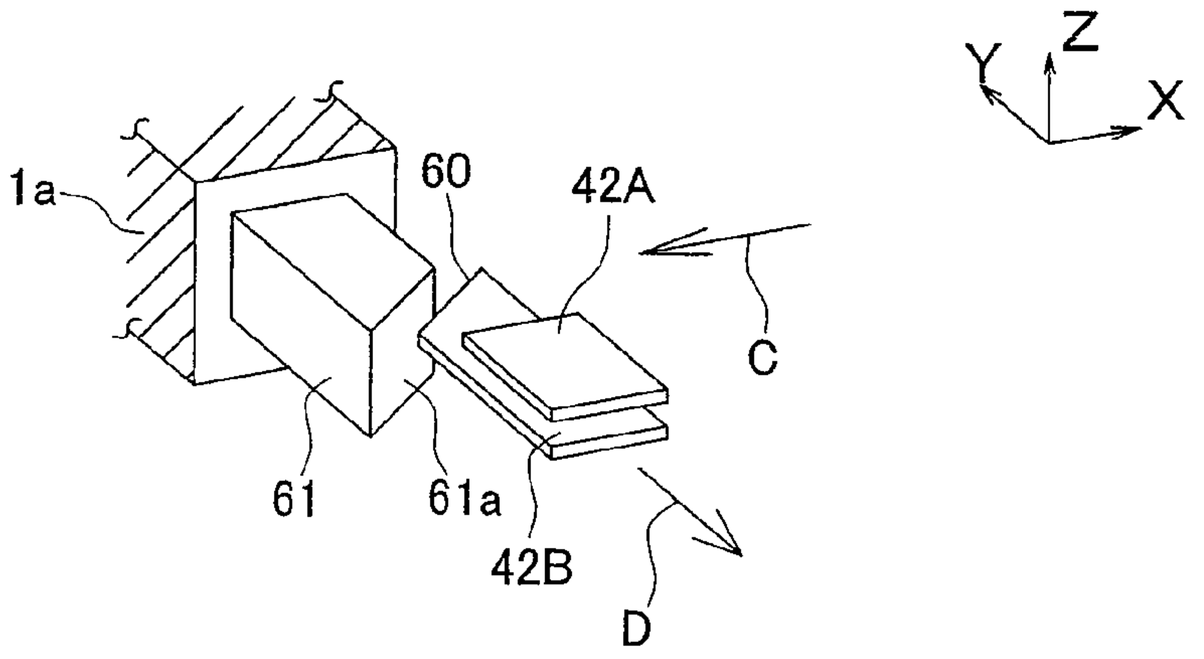


Fig. 13C

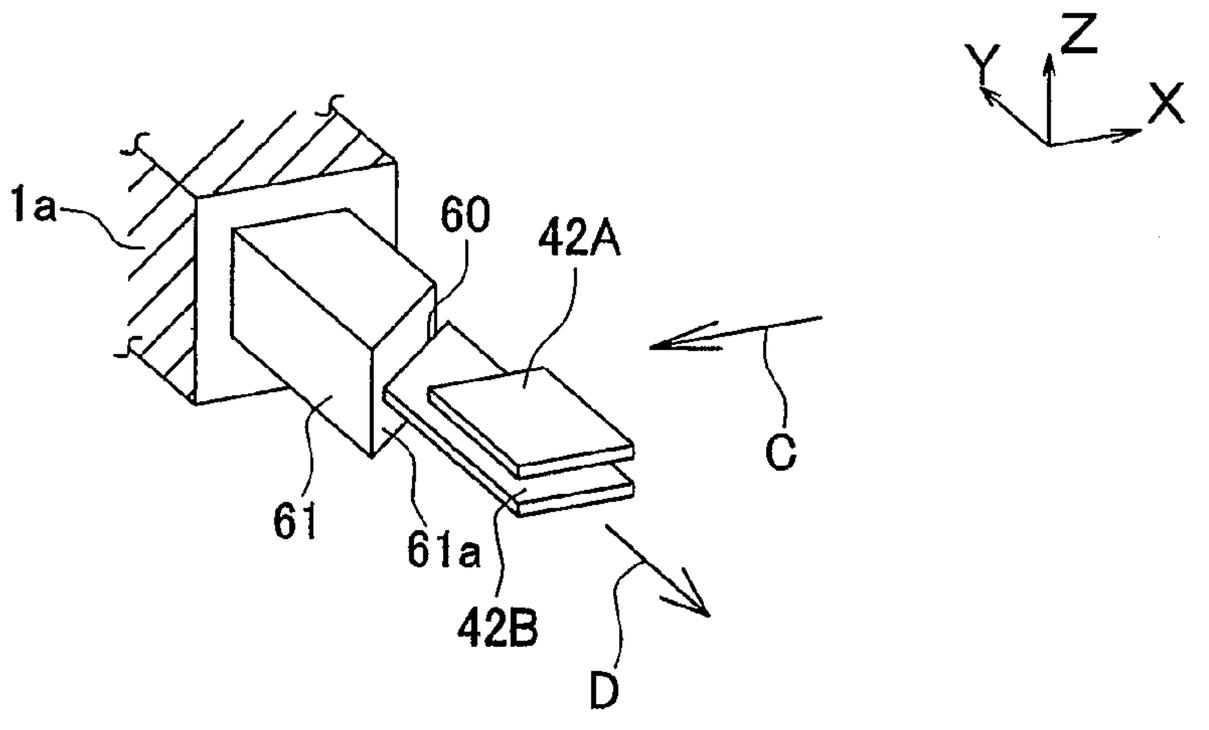


Fig. 14A

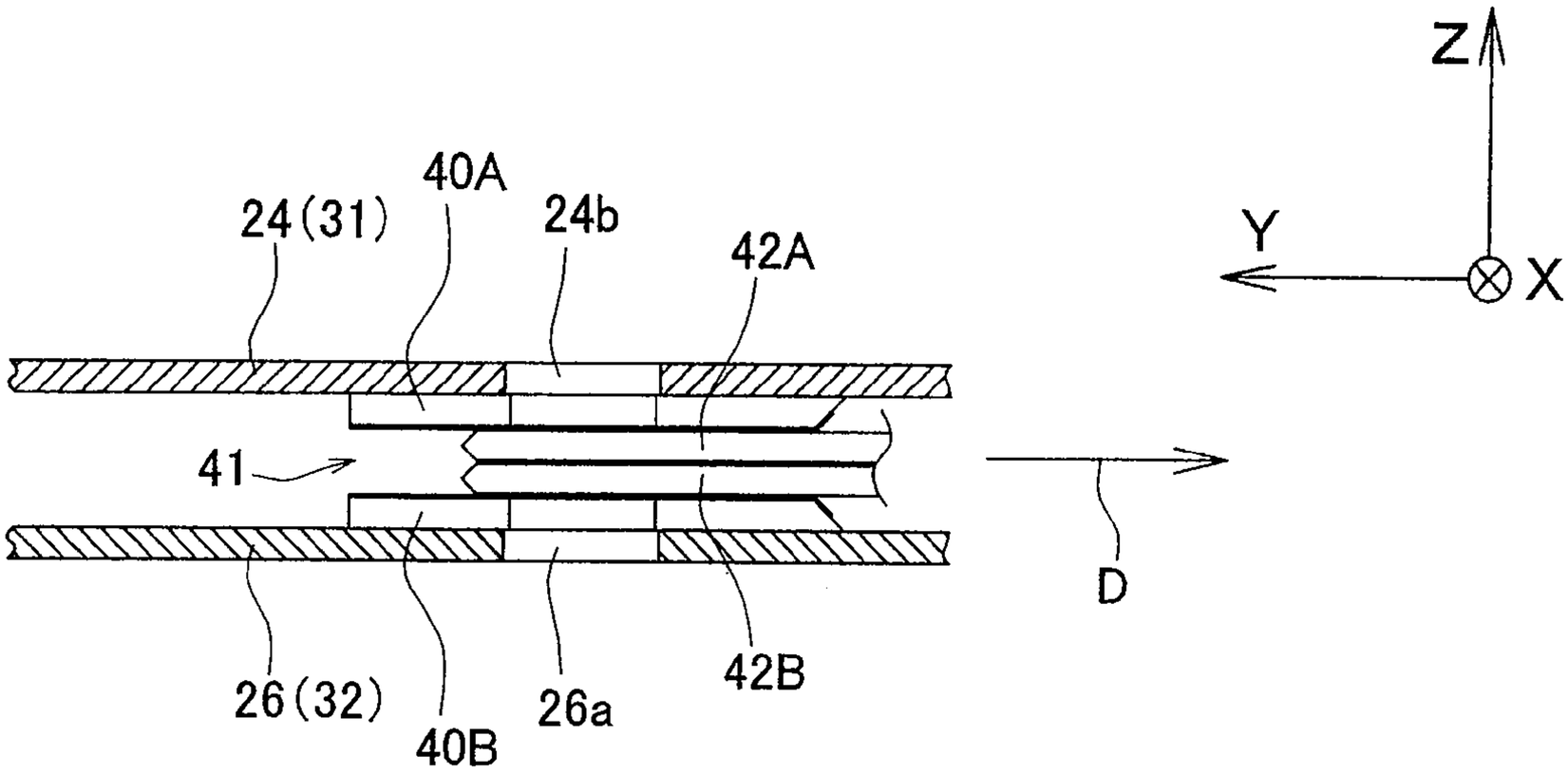


Fig. 14B

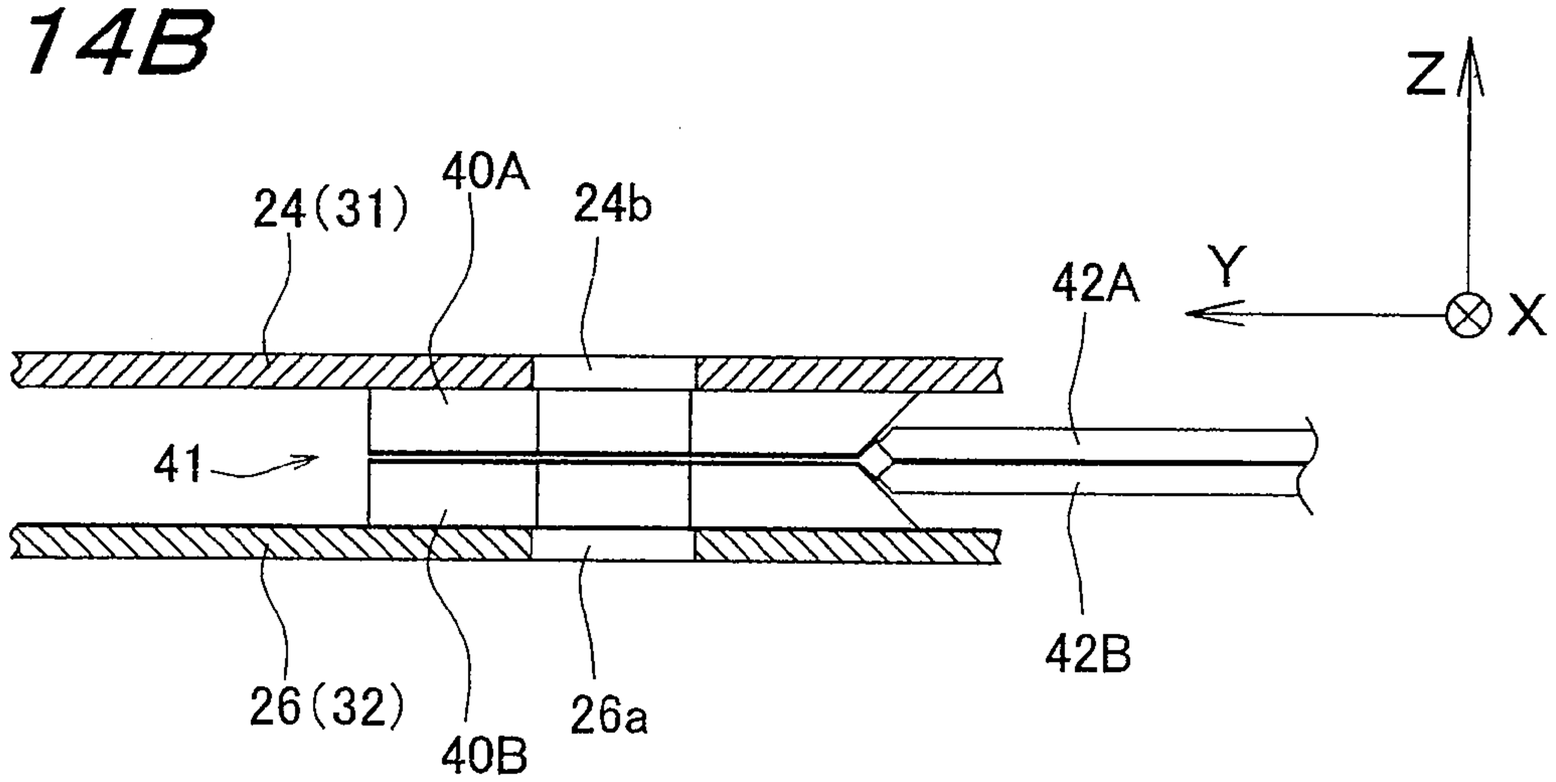


Fig. 15A

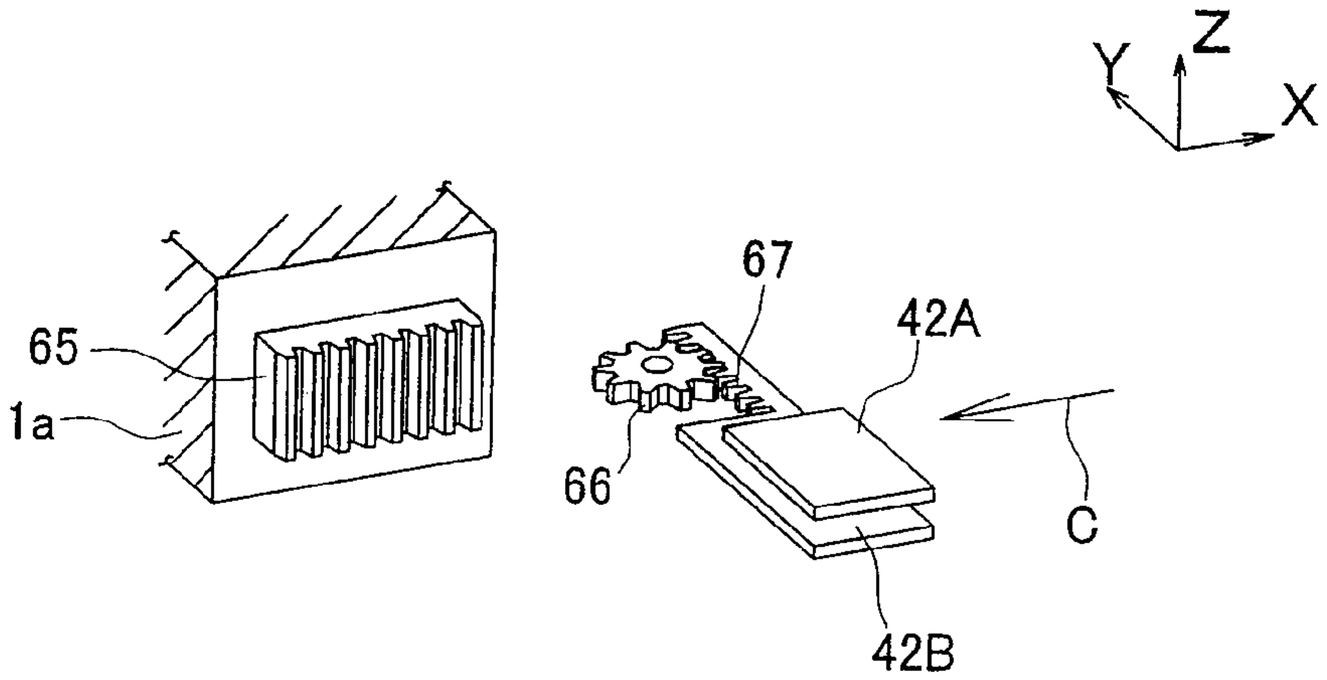


Fig. 15B

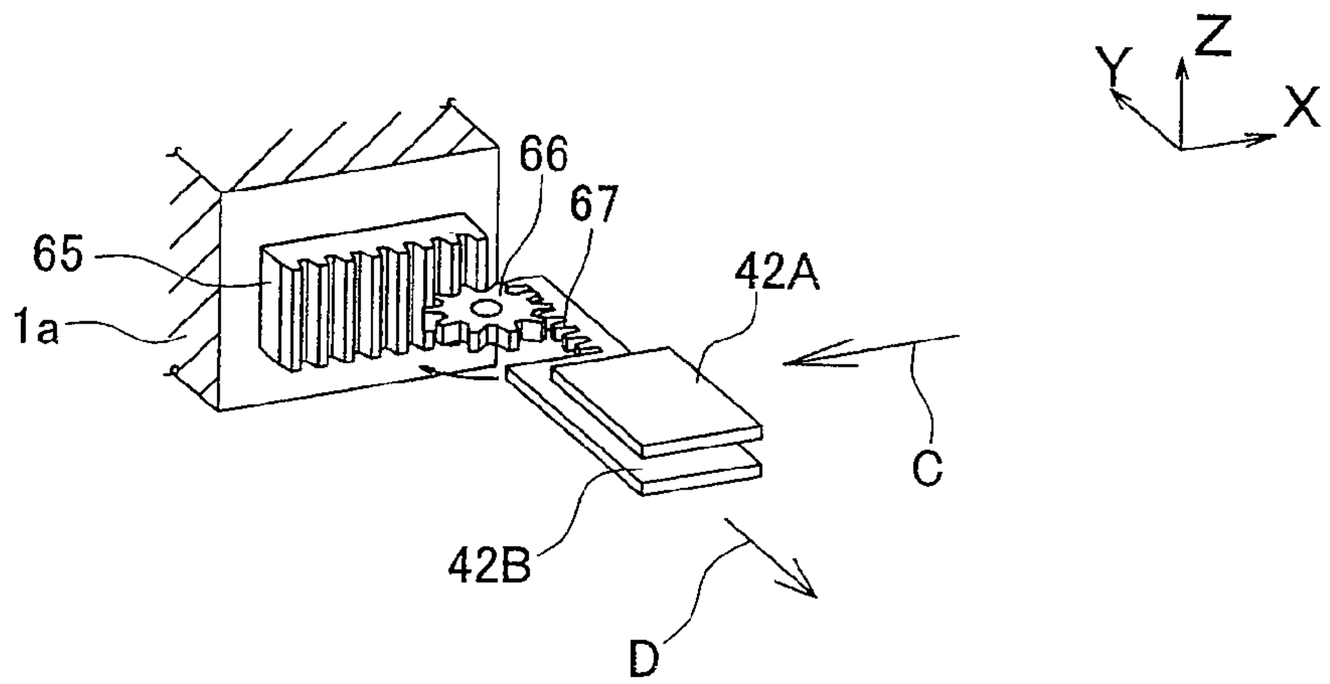


Fig. 15C

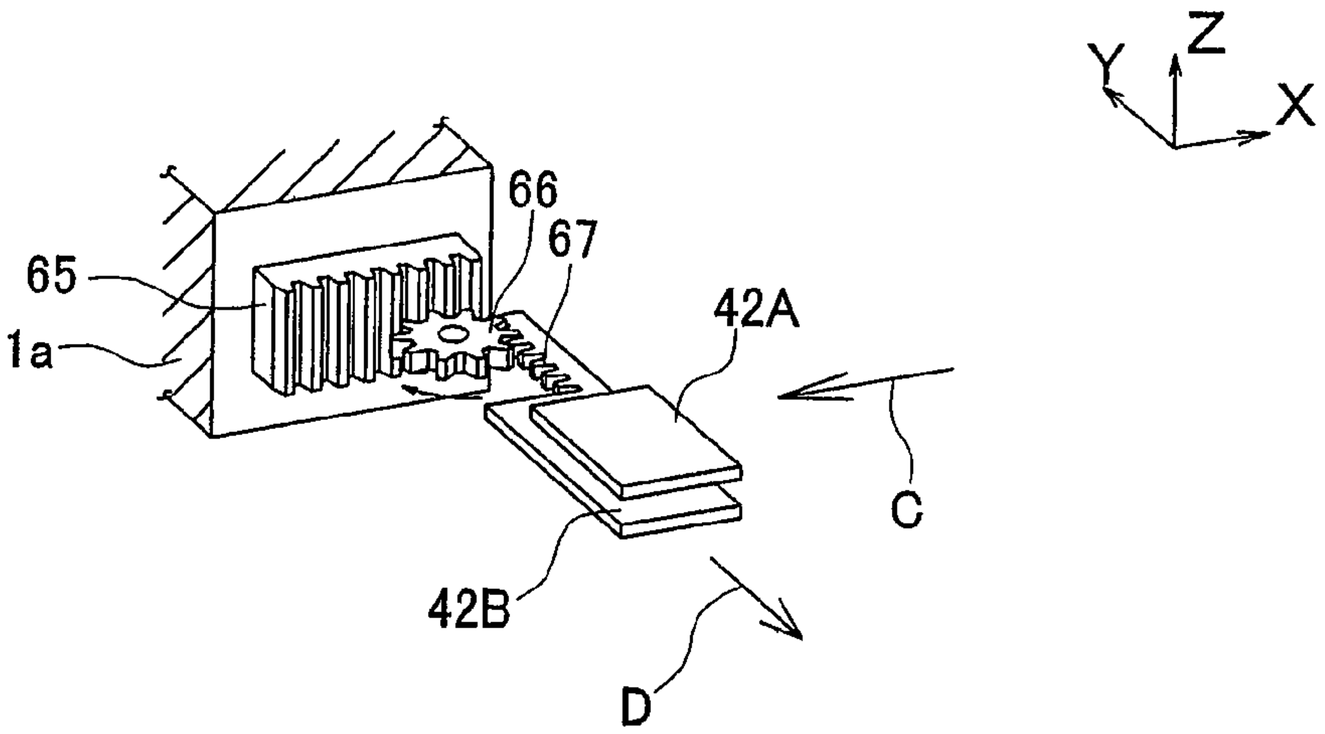


Fig. 16A

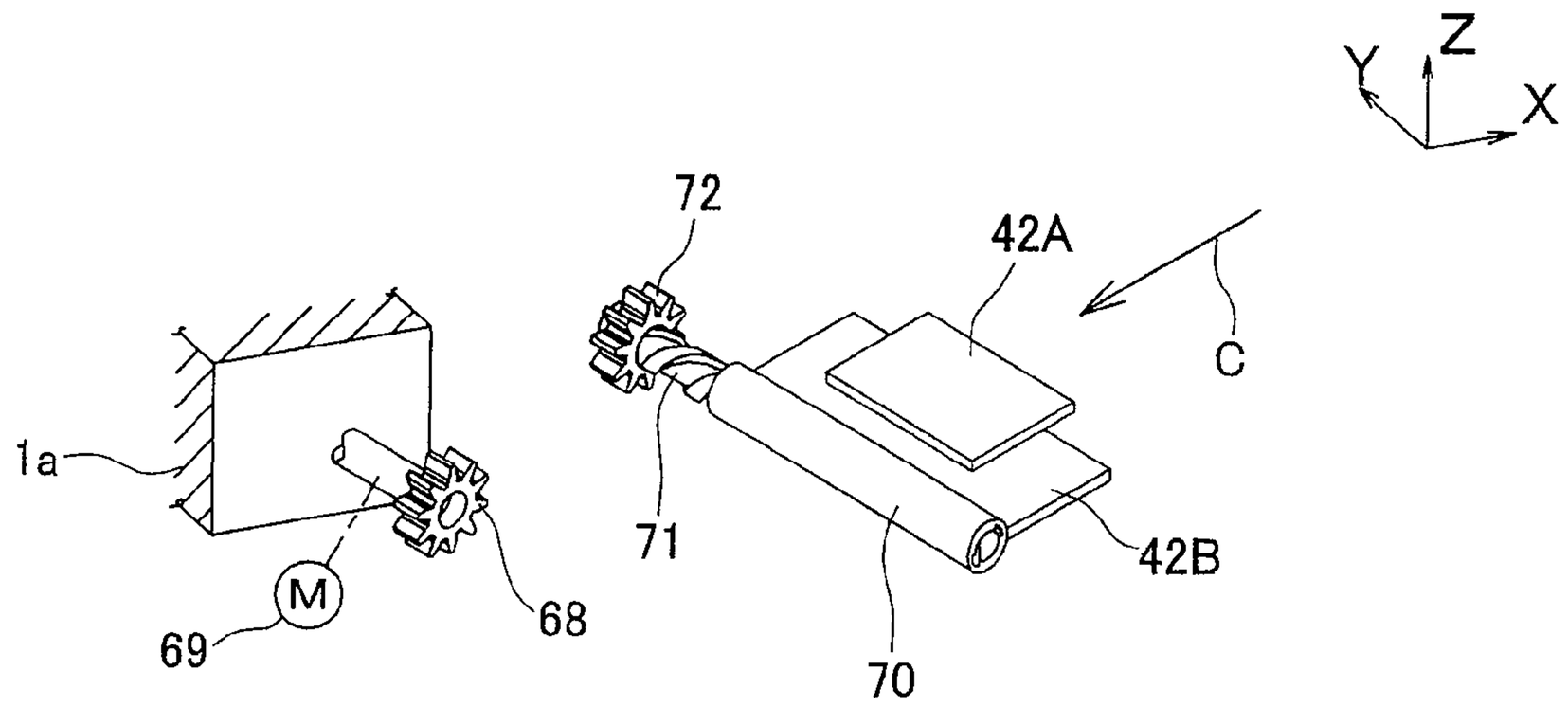
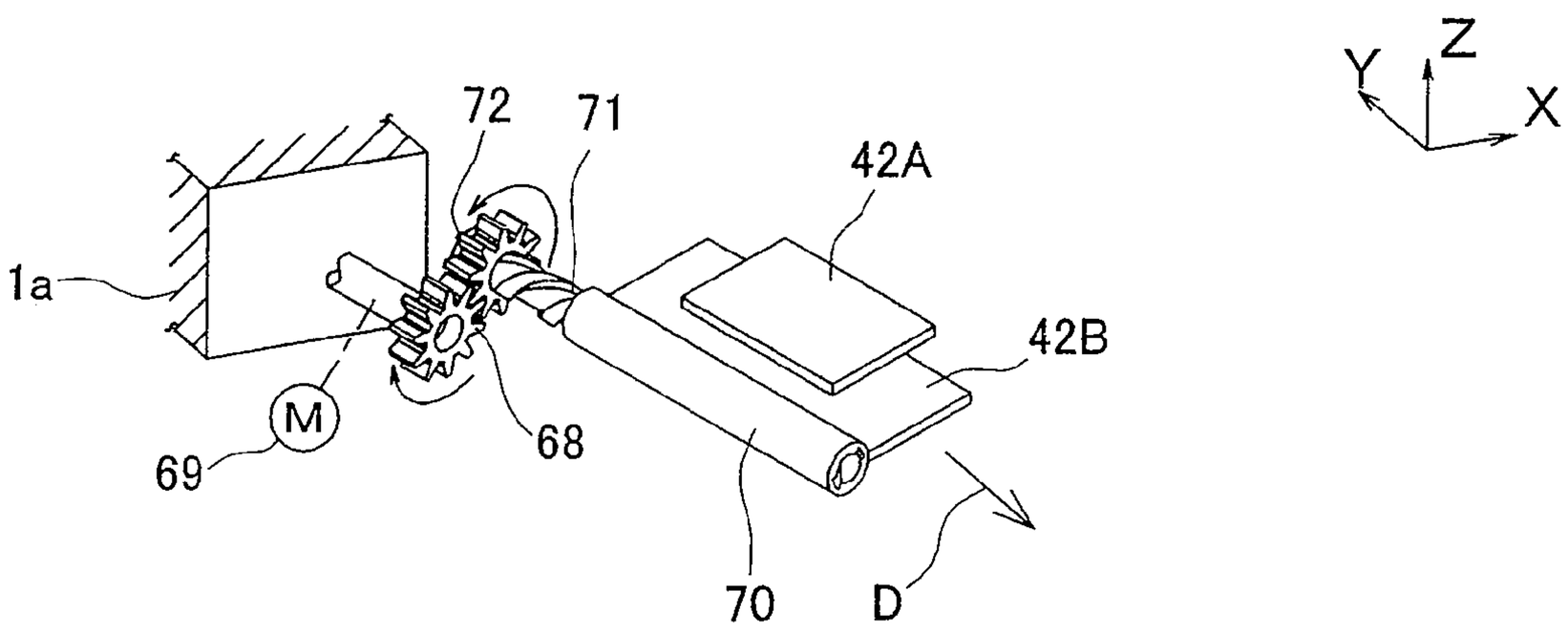


Fig. 16B



IMAGING CARTRIDGE AND IMAGE FORMING APPARATUS

RELATED APPLICATION

This application based on Japanese Patent Application No. 2007-225278 the contents in which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

The present invention relates to an imaging cartridge used for image forming apparatuses such as copying machines, facsimile machines, printers, and multi-functional machines.

For enhancing maintenanceability, an imaging cartridge has been known which can be loaded into and unloaded from an image forming apparatus body by providing such devices as an image bearing body, a charging device, a developing device, a transfer device, a cleaning device in the form of cartridges (see, e.g., Japanese Patent Application Laid-Open Publications 2002-268356 and 2005-107141). In this kind of imaging cartridge, with respect to a new toner box for storing unused toner to be fed to the developing device and a waste toner box for storing waste toner collected by the cleaning device, the following two aspects are generally known.

In the first aspect, the new toner box and waste toner box are consumable items independent of the imaging cartridge. In the second aspect, both of the new toner box and waste toner box are integrated with the imaging cartridge.

However, the first aspect increases the number of consumable items, resulting in complicated replacement procedures. Further, the second aspect requires replacement of the imaging cartridge for such reasons as exhaustion of the toner in the new toner box (toner empty) and the waste toner filling of the waste toner box (waste toner full) even if expensive components included in the imaging cartridge have not yet expired in life, thereby causing increase in total cost for ownership (TCO).

In order to solve these problems, it would be conceivable that the imaging cartridge is so structured that the new toner box and waste toner box are integrated with each other and are made detachable from the imaging cartridge so as to achieve both of the simplification of consumable item replacement procedures and the reduction in TCO. In the case of adopting this structure, it is necessary, with respect to the new toner box, to promptly feed toner to a predetermined section to the developing device. Further, with respect to the waste toner box, it is necessary to certainly prevent the leakage and scattering of toner during loading into and unloading from the image forming apparatus body.

However, those issues have not been addressed in the conventional imaging cartridges including those disclosed in Japanese Patent Application Laid-Open Publications 2002-268356 and JP 2005-107141. For example, Japanese Patent Application Laid-Open Publications 2002-268356 and JP 2005-107141 merely disclose, with respect to the new toner box detachable from the imaging cartridge, a mechanism for ensuring opening and closing of a shutter provided at a delivery opening to deliver toner to the developing device.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide an imaging cartridge having a new toner box and waste toner box integrated to each other and made detachable so as to achieve prompt feeding of toner from the new toner box to a developing device and reliable prevention of leakage and scattering of the toner from the waste toner box.

A first aspect of the present invention provides an imaging cartridge detachably loaded into an image forming apparatus body, comprising a process unit comprising at least an image bearing body, a developing device for developing an electrostatic latent image on the image bearing body to form a toner image, and a cleaning device for collecting toner remaining on the image bearing body after transfer of the toner image, a toner box unit integrally comprising a new toner box for storing unused toner to be fed to the developing device and a waste toner box for storing waste toner collected by the cleaning device, the toner box unit being detachably attached to the process unit, a first shutter mechanism movable to a close position which blocks movement of the toner through a first connecting section between the new toner box and developing device and an open position which permits the movement of the toner through the first connecting section, a second shutter mechanism movable to a close position which blocks movement of the toner through a second connecting section between the waste toner box and cleaning device and an open position which permits the movement of the toner through the second connecting section, a first shutter drive mechanism adapted to enable the first shutter mechanism to be moved between the close position and open position by manual operation when the process unit with the toner box unit attached thereto is out of the image forming apparatus body, and a second shutter drive mechanism for moving the second shutter mechanism from the close position to the open position during movement of the process unit with the toner box unit attached thereto to a predetermined position in the image forming apparatus or after completion of the movement to the predetermined position.

Since the imaging cartridge is a toner replenishment type cartridge in which the toner box unit formed by integrating the new toner box and the waste toner box is detachably attached to the process unit, the process unit generally including expensive components can be used as long as possible, thereby achieving reduction in TCO.

Moreover, since the toner box unit formed by integrating the new toner box and waste toner box is detachably attached to the process unit, the attaching and detaching procedures of the new toner box and the waste toner box, which are consumable items, with respect to the image forming apparatus body are simple and easy to understand.

Further, the first shutter mechanism at the first connecting section between the new toner box and developing device can be moved by the first shutter drive mechanism to the open position by manual operation when the process unit with the toner box unit attached thereto is out of the image forming apparatus body, so that toner starts to move from the new toner box to the developing device through the first connecting section before loading of the imaging cartridge into the image forming apparatus body is completed. This results in reduction of the time to replenish the developing device with toner after loading the imaging cartridge into the image forming apparatus body.

Furthermore, the second shutter mechanism at the second connecting section between the waste toner box and the cleaning device is moved by the second shutter drive mechanism from the close position to the open position during movement of the imaging cartridge to a predetermined position in the image forming apparatus or after completion of the movement to the prescribed position. This ensures prevention of leakage and scattering of the toner from the waste toner box during loading and unloading of the imaging cartridge with respect to the image forming apparatus body.

A second aspect of the present invention provides an image forming apparatus including the above-mentioned imaging cartridge.

According to the imaging cartridge of the present invention, in addition to the simplification of the replacement procedures of the new toner box and waste toner box as consumable items, it becomes possible to reduce the time to replenish the developing device with toner after loading of the imaging cartridge into the image forming apparatus body as well as to ensure prevention of leakage and scattering of the toner from the waste toner box during loading and unloading of the imaging cartridge with respect to the image forming apparatus body.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and characteristics of the present invention shall be clarified by the following description on the preferred embodiments with reference to the accompanying drawings.

FIG. **1** is a cross sectional view showing an image forming apparatus including an imaging cartridge according to an embodiment of the present invention;

FIG. **2** is a cross sectional view showing the image forming apparatus with a door opened;

FIG. **3** is a cross sectional view showing the imaging cartridge according to the embodiment of the present invention;

FIG. **4** is an exploded cross sectional view showing the imaging cartridge according to the embodiment of the present invention;

FIG. **5** is a perspective view showing the imaging cartridge according to the embodiment of the present invention;

FIG. **6** is an exploded perspective view showing the imaging cartridge according to the embodiment of the present invention;

FIG. **7**A is a schematic perspective view showing shutters of the new toner box and developing device before being coupled;

FIG. **7**B is a schematic perspective view showing the shutters of the new toner box and developing device after being coupled;

FIG. **8** is a partial plan view showing the vicinity of a control lever of the new toner box;

FIG. **9** is a partial perspective view showing the vicinity of the control lever of the new toner box;

FIG. **10**A is a partial sectional view showing operation in the vicinity of the control lever during attachment of the toner box unit to the process unit;

FIG. **10**B is a partial sectional view showing operation in the vicinity of the control lever during attachment of the toner box unit to the process unit;

FIG. **10**C is a partial sectional view showing operation in the vicinity of the control lever during attachment of the toner box unit to the process unit;

FIG. **10**D is a partial sectional view showing operation in the vicinity of the control lever during attachment of the toner box unit to the process unit;

FIG. **10**E is a partial sectional view showing operation in the vicinity of the control lever during attachment of the toner box unit to the process unit;

FIG. **11**A is a partial sectional view showing a connecting section of the new toner box and developing device when the shutters of the new toner box and developing device are in a close position;

FIG. **11**B is a partial sectional view showing the connecting section of the new toner box and developing device when the shutters of the new toner box and the developing device are in a close position;

FIG. **12**A is a schematic perspective view showing the shutters of the cleaning device and waste toner box before being coupled;

FIG. **12**B is a schematic perspective view showing the shutters of the cleaning device and waste toner box after being coupled;

FIG. **13**A is a schematic perspective view showing the shutters of the cleaning device and waste toner box before coming into contact with a fixed cam section;

FIG. **13**B is a schematic perspective view showing the shutters of the cleaning device and waste toner box at the time of starting movement to an open position upon coming into contact with the fixed cam section;

FIG. **13**C is a schematic perspective view showing the shutters of the cleaning device and waste toner box during movement to the open position upon coming into contact with the fixed cam section;

FIG. **14**A is a partial sectional view showing the connecting section of the waste toner box and the cleaning device when the shutters of the cleaning device and waste toner box are in a close position;

FIG. **14**B is a partial sectional view showing the connecting section of the waste toner box and cleaning device when the shutters of the cleaning device and waste toner box are in an open position;

FIG. **15**A is a schematic perspective view showing the shutters of the cleaning device and waste toner box before a pinion gears with a fixed rack;

FIG. **15**B is a schematic perspective view showing the shutters of the cleaning device and waste toner box at the time of starting movement to the open position upon gearing of the pinion with the fixed rack;

FIG. **15**C is a schematic perspective view showing the shutters of the cleaning device and waste toner box during movement to the open position upon gearing of the pinion with the fixed rack;

FIG. **16**A is a schematic perspective view showing the shutters of the cleaning device and waste toner box before a driving gear gears with a driven gear; and

FIG. **16**B is a schematic perspective view showing the shutters of the cleaning device and waste toner box during movement to the open position upon transmission of rotation from the driving gear to the driven gear.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** shows an image forming apparatus (tandem-type color laser printer) **1** having an imaging cartridge according to an embodiment of the present invention. In the accompanying drawings, X axis direction denotes an anteroposterior direction of the image forming apparatus **1**, Y axis direction denotes a width direction of the image forming apparatus **1** which is perpendicular to the X axis direction, and Z axis direction denotes a height direction of the image forming apparatus **1**.

Arranged inside an apparatus main frame **1***a* of the image forming apparatus **1** is a transfer belt **2** stretched over a plurality of rollers. Also in the apparatus main frame **1***a*, four imaging cartridges **4**Y, **4**M, **4**C and **4**K of yellow, magenta, cyan and black are arranged in the longitudinal direction on a rear-face side of the apparatus main frame **1***a* (left-hand side in FIG. **1**) with respect to the transfer belt **2**. Further, accommodated in the apparatus main frame **1***a* on a further rear-face side from the imaging cartridges **4**Y to **4**K are, a laser exposure device **5**, an electric power unit **6** for supplying electric power to the entire apparatus, and a control device **8** for controlling operation of each section. Placed on an upper side

of the apparatus main frame **1***a* are a fixing device **9** and a paper ejection device **12** composed of a paper ejection roller **10** and a paper ejection tray **11**. A sheet feeding device **16** having a paper cassette **14** and a feed roller **18** is arranged on a lower side of the apparatus main frame **1***a*. The paper cassette **14** can be attached to and detached from a front-face side of the apparatus main frame **1***a* (right-hand side in FIG. **1**). A door **1***b* which can be rotated around a pivot **17** so as to be openable and closable is provided on the front-face side of the apparatus main frame **1***a*, and the transfer belt **2** is placed in the door **1***b*. As shown in FIG. **2**, as the door **1***b* is opened, the transfer belt **2** is put in a escape position, where the imaging cartridges **4**Y to **4**K can be loaded into and unloaded from the front-face side of the apparatus main frame **1***a*.

Also with reference to FIG. **3**, each of the imaging cartridges **4**Y to **4**K is provided with a cylindrical photoconductor (image bearing body) **21** provided in a rotatable manner as well as a charging device **22**, a developing device **23**, and a cleaning device **24** which are arranged around the photoconductor **21**. Moreover, each of the imaging cartridges **4**Y to **4**K is provided with a new toner box **25** for storing unused toner and a waste toner box **26** for storing waste toner arranged above the new toner box **25**. Toner corresponding to one among yellow, magenta, cyan, and black is stored in the new toner box **25** of each of the imaging cartridges **4**Y to **4**K. The transfer device **27** is arranged so as to face the photoconductor **21** of each of the imaging cartridges **4**Y to **4**K across the transfer belt **2** (see FIGS. **1** and **2**).

Brief description is now given of the process in each of the imaging cartridges **4**Y to **4**K. First, the photoconductor **21** is charged by the charging device **22**, and then is irradiated with a laser beam from the laser exposure device **5** to form an electrostatic latent image on the photoconductor **21** according to image signals. With the toner fed from the new toner box **25**, the developing device **23** develops the electrostatic latent image on the photoconductor **21** to form a toner image. Toner that remains on the photoconductor **21** even after transfer of the toner image to a paper sheet or recording medium "P" by the transfer device **27** is collected by the cleaning device **24** and stored in the waste toner box **26**.

The image forming apparatus **1** is a type in which the recording medium "P" is fed from the paper sheet cassette **14** to the front-face side and transported upward with an image being formed thereon meanwhile, and then discharged to the rear-face side. More specifically, the recording medium "P" is sent out from the paper sheet cassette **14** to the front-face side sheet by sheet by the feed roller **13**, electrostatically held by the transfer belt **2** after passing through a timing roller **15** and conveying roller **7**, and then transported upward. Whenever the recording medium "P" passes between the photoconductor **21** and the transfer device **27** in each of the imaging cartridges **4**Y to **4**K, a toner image of one color is electrostatically transferred thereon. The recording medium "P" with toner images transferred thereon in superimposition one on another by the imaging cartridges **4**Y to **4**K is transported to the fixing device **9** for fixing the toner image by heating and pressurization, and then the recording medium "P" is discharged by the paper ejection roller **10** to the paper ejection tray **11**.

Description is now given of the imaging cartridges **4**Y to **4**K in detail. Hereinafter, when it is not necessary to distinguish four imaging cartridges **4**Y to **4**K, reference numeral "4" is used to denote the imaging cartridge.

With reference to FIG. **3** through FIG. **5**, the imaging cartridge **4** of the present embodiment comprises a process unit **31** and toner box unit **32**. The toner box unit **32** is detachably attached to the process unit **31**.

The process unit **31** comprises the photoconductor **21**, charging device **22**, developing device **23**, and cleaning device **24**. The cleaning device **24** comprises a cleaning blade **24***a* for collecting toner from the surface of the photoconductor **21**, a waste side toner delivery opening **24***b* provided in a position away from the photoconductor **21** and opened downward, and a conveying roller **24***c* and conveying screw **24***d* for transporting the toner collected by the cleaning blade **24***a* to the waste side toner delivery opening **24***b*. The charging device **22** has a charging roller **22***a* for charging. The developing device **23** comprises a developing roller **23***a*, development side toner reception opening **23***b* provided in a position away from the developing roller **23***a* and opened upward, and a conveying screw **23***c* and conveying rollers **23***d*, **23***e* for transporting toner from the development side toner reception opening **23***b* to the developing roller **23***a*.

As most clearly shown in FIGS. **3** and **4**, a reception space **33** is provided in a portion of the process unit **31** on its one side opposite to the photoconductor **21**. The reception space **33** is a horizontally long space with its upper end being defined by a portion near the waste side toner delivery opening **24***b* of the cleaning device **24**, and its lower end being defined by a portion near the development side toner reception opening **23***b* of the developing device **23**. The process unit **32** also includes a pedestal section **34** which projects from the developing device **23** toward its one side opposite to the photoconductor **21** at a position lower than the reception space **33**.

The toner box unit **32** is composed of a new toner box **25** and a waste toner box **26** which are detachably attached to the process unit **31**. The new toner box **25** and the waste toner box **26** are integrally coupled to each other in a manner allowing elastic relative displacement by a helical compression spring **35**. Since the imaging cartridge **4** is formed as a toner replenishment type cartridge in which the new toner box **25** and the waste toner box **26** can be attached to and detached from the process unit **31**, the process unit **31** generally including expensive components can be used as long as possible, thereby allowing reduction in TCO. Moreover, since the new toner box **25** and the waste toner box **26** are detachably attached to the process unit **31**, the attaching and detaching procedures of the new toner box **25** and the waste toner box **26**, which are consumable items, to/from the image forming apparatus body **1***a* are simple and easy to understand.

The new toner box **25** is a box for storing therein unused toner fed to the developing device **23**. The new toner box **25** has a development side toner delivery opening **25***a* opened downward in a region positioned above the development side toner reception opening **23***b* of the developing device **23** at the time of its attachment to the process unit **31**. An unshown conveying screw is placed near the upper side of the development side toner delivery opening **25***a*. With reference to FIGS. **11**A and **11**B, the development side toner delivery opening **25***a* and the development side toner reception opening **23***b* each have a through hole formed therein, and are also equipped with elastically deformable sealing members **36**A and **36**B made of materials such as urethane. Moreover, PET films are stuck on apical surfaces of the sealing members **36**A and **36**B. In the state that the toner box unit **32** is attached to the process unit **31**, the development side toner delivery opening **25***a*, the development side toner reception opening **23***b*, and the sealing members **36**A and **36**B function as a connecting section **37** which is a passage of the toner from the new toner box **25** to the developing device **23**.

The new toner box **25** includes a shutter (new toner box side shutter) **38**A which opens and closes the development side toner delivery opening **25***a*. Similarly, the process unit **32**

includes a shutter (developing device side shutter) **38**B which opens and closes the development side toner reception opening **23***b* of the developing device **23**. By retracting these shutters **38**A and **38**B from between the sealing member **36**A and **36**B, the connecting section **37** can be opened so that the development side toner delivery opening **25***a* and the development side toner reception opening **23***b* is communicated with each other. The shutters **38**A and **38**B as well as the mechanism for driving these shutters will be described in detail later.

The waste toner box **26** is a box for storing therein the waste toner collected by the cleaning device **23**. The waste toner box **26** has a waste side toner reception opening **26***a* opened upward in a region positioned under the waste side toner delivery opening **24***b* of the cleaning device **24** at the time of its attachment to the process unit **31**. A conveying screw **26***b* is placed near the lower side of the waste side toner reception opening **26***a*. With reference to FIGS. **14**A and **14**B, sealing members **40**A and **40**B similar to those of the development side toner delivery opening **25***a* and the development side toner reception opening **23***b* are attached to the waste side toner delivery opening **24***b* and the waste side toner reception opening **26***a*, respectively. In the state that the toner box unit **32** is attached to the process unit **31**, the waste side toner delivery opening **24***b*, the waste side toner reception opening **26***a*, and the sealing members **40**A and **40**B function as a connecting section **41** which is a passage of the toner from the cleaning device **24** to the waste toner box **26**.

The process unit **32** includes a shutter (cleaning device side shutter) **42**A which opens and closes the waste side toner delivery opening **24***b* of the cleaning device **24**. Similarly, the waste toner box **26** includes a shutter (waste toner box side shutter) **42**B which opens and closes the waste side toner reception opening **26***a*. By retracting these shutters **42**A and **42**B from between the sealing member **40**A and **40**B, the connecting section **41** can be opened so that the waste side toner delivery opening **24***b* and the waste side toner reception opening **26***a* is communicated with each other. The shutters **42**A and **42**B as well as the mechanism for driving these shutters will be described in detail later.

The region near the development side toner delivery opening **25***a* of the new toner box **25** and the region near the waste side toner reception opening **26***a* of the waste toner box **26** constitute an insertion section **43** to be inserted into the reception space **37** provided on the process unit **31** side. The toner box unit **32** is detachably attached to the process unit **31** by inserting the insertion section **43** into the reception space **37** and mounting the bottom side of the new toner box **25** on the above-mentioned pedestal section **34**.

Description is now given of the shutters **38**A and **38**B which open and close the development side toner delivery opening **25***a* and the development side toner reception opening **23***b*, as well as the drive mechanism (first shutter drive mechanism) therefor.

The shutter **38**A of the development side toner delivery opening **25***a* is slidably attached to the new toner box **25**. The sliding direction of the shutter **38**A is a direction approximately perpendicular to the attachment direction of the toner box unit **32** to the process unit **31** (an arrow "A" in FIG. **4** and FIG. **7**A), i.e., a width direction of the process unit **31** and the toner box unit **32** (Y axis direction). As shown in FIGS. **7**A and **7**B, a coupling protrusion section **45** is provided on a lower surface of the distal end side of the shutter **38**A. The proximal end side of the shutter **38**A is coupled to a control lever **46** for manual operation. The distal end side of the control lever **46** is coupled to the proximal end side of the shutter **38**A on the upper surface of the new toner box **25**, while the proximal end side of the control lever **46** is positioned in a lateral section of the new toner box **25** opposite to the insertion section **43**. Therefore, it becomes possible to access to the control lever **46** even when the toner box unit **32** is attached to the process unit **31**.

The shutter **38**B of the development side toner reception opening **23***b* is slidably attached to the developing device **23**. The sliding direction of the shutter **38**B on the developing device **23** side is identical to the sliding direction of the shutter **38**A on the new toner box **25** side. Moreover, a coupling recess section **47** is provided on the upper surface side of the shutter **38**B.

With reference to FIGS. **4**, **7**A and **7**B, when the toner box unit **31** is inserted into the process unit **31**, the coupling protrusion section **45** of the shutter **38**A on the new toner box **25** side fits into the coupling recess section **47** on the developing device **23** side, by which the shutters **38**A and **38**B are removably coupled to each other. As a result, the shutters **38**A and **38**B can move, in the width direction of the toner box unit **32** and the process unit **31** (Y axis direction), between a position which closes the development side toner delivery opening **25***a* and the development side toner reception opening **23***b*, i.e., a close position (FIG. **11**A) which blocks movement of the toner through the connecting section **37** of the new toner box **25** and the developing device **23**, and a position which opens the development side toner delivery opening **25***a* and the development side toner reception opening **23***b*, i.e., an open position (FIG. **11**B) which allows movement of the toner through the connecting section **37**.

A locking mechanism shown below is provided which enables the control lever **46** to be operated only when the toner box unit **32** is attached to the process unit **31**. With reference to FIG. **8** to FIG. **10**E, a lock claw **51** projecting downward is provided on the proximal end side of the control lever **46**. An engagement face **51***a* to be engaged with the end face of a lock plate **52** which projects from the new toner box **25** is formed in one lateral section of the lock claw **51**. Also, an inclined face **51***b* is formed on the other lateral section of the lock claw **51**. A lock releasing lever **53** is attached to the vicinity of the distal end of the pedestal section **34** of the process unit **31**. The lock releasing lever **53** can rotate around a revolving shaft extending in the direction (Y axis direction) perpendicular to the attachment direction of the toner box unit **32** to the process unit **31** (arrow "A" in FIG. **4**). One end of the lock releasing lever **53** constitutes a lock releasing section **53***a* which is positioned in a lateral section of the new toner box **25** when the toner box unit **32** is attached to the process unit **31**. The other end of the lock releasing section **53***a* constitutes a fixed section **53***b* which is to be positioned on the bottom of the new toner box **25** when the toner box unit **32** is attached to the process unit **31**. A pin member **54** movable only in the attachment direction of the toner box unit **32** to the process unit **31** (X axis direction) is held in the vicinity of the distal end of the pedestal section **34** of the process unit **31**. A concave **25***b* for housing the fixed section **53***b* of the lock releasing lever **53** and the pin member **54** is formed on the bottom of the new toner box **25**.

Description is now given of the shutters **42**A and **42**B which open and close the waste side toner delivery opening **24***b* and the waste side toner reception opening **26***a* as well as the drive mechanism (second shutter drive mechanism) therefor.

The shutter **42**A of the waste side toner delivery opening **24***b* is slidably attached to the cleaning device **24**. The sliding direction of the shutter **42**A, similar to that of the above-mentioned shutters **38**A and **38**B, is a direction approximately perpendicular to the attachment direction of the toner

box unit **32** to the process unit **31**, i.e., a width direction of the process unit **31** and the toner box unit **32**. As shown in FIGS. **12**A and **12**B, a coupling recess section **58** is provided on the lower surface of the shutter **42**A.

The shutter **42**B of the waste side toner reception opening **26***a* is slidably attached to the waste toner box **26**. The sliding direction on the waste toner box **26**B side is identical to the sliding direction of the shutter **42**A on the cleaning device **24** side. Moreover, a coupling protrusion section **59** is provided on the upper surface side of the shutter **42**A. Further, a cam follower face (a cam follower section) **60** which is constituted of an inclined face is formed in one end section of the shutter **42**A. As shown in FIGS. **13**A to **13**C, in the apparatus body **1***a* of the image forming apparatus **1**, a fixing cam member **61** which projects in the width direction (Y axis direction) is placed in the vicinity of a predetermined loading position of the imaging cartridge **4**. A fixing cam face (fixed cam section) **61***a* constituted of an inclined face is formed at the distal end of the fixing cam member **61**. The cam follower face may be formed not in the shutter **42**A but in the shutter **42**B, or the cam follower face may be formed in both the shutters **42**A and **47**B.

With reference to FIGS. **4**, **12**A and **12**B, the coupling protrusion section **59** of the shutter **42**B on the waste toner box **26** side fits into the coupling recess section **58** on the cleaning device **24** side, by which the shutters **42**A and **47**B are removably coupled to each other. As a result, the shutters **42**A and **47**B can move integrally, in the width direction of the toner box unit **32** and the process unit **31** (Y axis direction), between a position which closes the waste side toner delivery opening **24***b* and the waste side toner reception opening **26***a*, i.e., a close position (FIG. **14**A) which blocks movement of the toner through the connecting section **41** of the cleaning device **24** and the waste toner box **26**, and a position which opens the waste side toner delivery opening **24***a* and the waste side toner reception opening **23***b*, i.e., an open position (FIG. **14**B) which allows movement of the toner through the connecting section **41**.

Description is now given of the procedures for attaching the toner box unit **32** to the process unit **31** and further loading the imaging cartridge **4** onto the apparatus main frame **1***a*.

First, as shown by arrow "A" in FIG. **4**, in order to attach the toner box unit **32** to the process unit **31**, the insertion section **43** of the toner box unit **32** is inserted into the reception space **33** of the process unit **31**.

When the toner box unit **32** is in the state of being detached from the process unit **31**, the engagement face **51***a* of the lock claw **51** of the control lever **46** is engaged with a lateral face of the lock plate **52**, so that the control lever **46** is held in a prescribed position (a position where the shutter **37**A is at a close position). As the toner box unit **32** is inserted into the process unit **31**, first the fixed section **53***b* of the lock releasing lever **53** and the pin member **54** enter into the concave **25***b* in the new toner box **25** (FIGS. **10**A and **10**B). In this case, the pin member **54** is positioned below the fixed section **53***b* of the lock releasing lever **53**. As the toner box unit **32** is inserted further, the fixed section **53***b* is pushed by the edge of the concave **25***b*, which rotates the lock releasing lever **53** clockwise in the drawings (FIGS. **10**B and **10**C). As a result, the pin member **54** moves around the distal end of the fixed section **53***b* toward the upper side of the fixed section **53***b* (FIGS. **10**D and **10**E). With the fixed section **53***b* being interposed between the fixed section **53** and the bottom of the concave **25***b*, the lock releasing lever **53** maintains a posture being rotated clockwise to some extent. With the lock releasing lever **53** in this posture, the lock releasing section **53***a* can push the lock claw **51** of the control lever **46** upward, so that the lower end of the lock claw **51** goes up to the upper surface of the lock plate **52**. As a result, the control lever **46** becomes movable in the direction shown by arrow "B" in FIG. **9**.

Upon completion of attachment of the toner box unit **32** to the process unit **31**, the shutter **38**A on the new toner box **25** side and the shutter **38**B on the developing device **23** side are coupled to each other (FIG. **7**B), while the shutter **42**A on the cleaning device **24** side and the shutter **42**B on the waste toner box **26** side are coupled to each other (FIG. **7**A).

By manually operating the control lever **46** after the attachment of the toner box unit **32** to the process unit **31** is completed, the shutters **38**A and **38**B are moved from the close position (FIG. **7**A) to the open position (FIG. **7**B). Thus, after the attachment of the toner box unit **32** to the process unit **31** and before loading of the imaging cartridge **4** into the apparatus body **1***a*, the shutters **38**A and **38**B can be moved to the open position by manual operation of the control lever **46**, by which the connecting section **37** of the new toner box **25** and the developing device **23** can be opened. Therefore, toner starts to move from the new toner box **25** to the developing device **23** through the opened connecting section **37** before loading of the imaging cartridge into the apparatus body **1***a* is completed. As a result, it becomes possible to reduce the time to replenish the developing device **23** with toner after loading the imaging cartridge **4** into the apparatus body **1***a*.

Moreover, as mentioned above, before the attachment of the toner box unit **32** to the process unit **31** is completed, the control lever **46** is not movable as it is locked by the lock claw **51** being engaged with the lock plate **52**, which makes it possible to prevent the toner delivery opening **25***a* of the new toner box **25** from being opened before attachment to the process unit **31** and thereby makes it possible to prevent leakage and scattering of the toner from the new toner box **25**.

Once the attachment of the toner box unit **32** to the process unit **31** is completed, as mentioned above, the shutters **42**A and **42**B on the cleaning device **24** side and the waste toner box **26** side are coupled to each other. However, in the state where the imaging cartridge **4** is unloaded from the apparatus body **1***a*, the shutters **42**A and **42**B are held in the close position, which prevents leakage and scattering of the toner from the connecting section **41** of the cleaning device **24** and the waste toner box **26** (the waste side toner delivery opening **24***b* and the waste side toner reception opening **26***a*).

Next, as shown by arrow "C" in FIGS. **13**A to **13**C, the imaging cartridge **4** is loaded into the apparatus body **1***a*. When the imaging cartridge **4** is in the process of being moved to a prescribed position in the apparatus body **1***a*, the shutters **42**A and **42**B on the cleaning device **24** side and the waste toner box **26** side move to open the connecting section **41** of the cleaning device **24** and the waste toner box **26**. As the imaging cartridge **4** is inserted into the apparatus body **1***a*, the cam follower face **60** of the shutter **42**A comes into contact with a fixing cam face **61***a* of the fixing cam member **61** on the apparatus body **1***a* side (FIGS. **13**A and **13**B). As the imaging cartridge **4** is inserted further, the cam follower face **60** is pushed by the cam face **61***a*, so that as shown by arrow "D", the shutters **42**A and **42**B move in the width direction of the imaging cartridge **4** (Y axis direction) from the close position toward the open position (FIGS. **13**B and **13**C). When the imaging cartridge **4** reaches a prescribed position in the apparatus body **1***a*, the shutters **42**A and **42**B reach the open position, where the connecting section **41** of the cleaning device **24** and the waste toner box **26** is opened Thus, since the shutters **42**A and **42**B move from the close position to the open position when the imaging cartridge **4** is in the process of being moved to the prescribed position in the apparatus body **1***a*, it becomes possible to ensure prevention of leakage

and scattering of the toner from the connecting section **41** of the cleaning device **24** and the waste toner box **26** during loading and unloading of the imaging cartridge to/from the apparatus body **1***a*.

FIGS. **15**A to **15**C show an alternative drive mechanism for the shutters **42**A and **42**B which open and close the waste side toner delivery opening **24***b* and the waste side toner reception opening **26***a*. First, a rack (first rack) **65** is fixed to the apparatus body **1***a* side of the image forming apparatus **1**. Moreover, a pinion **66** is supported rotatably around a Z axis on the upper surface side of the waste toner box **26**. Further, the shutter **42**B on the waste toner box **26***a* side has a rack (second rack) **67** extending in the moving direction of the shutters **42**A and **42**B (Y axis direction). The rack **67** gears with the pinion **66**.

As the imaging cartridge **4** is inserted into the apparatus body **1***a*, the pinion **66** is engaged with the fixed rack **65** (FIGS. **15**A and **15**B). As the imaging cartridge **4** is inserted further, the pinion **66** rotates by engagement with the rack **65**. The rotation of the pinion **66** is converted into a linear motion by engagement of the pinion **66** and the rack **65**, and so the shutters **42**A and **42**B move from the close position toward the open position as shown by arrow "D" (FIGS. **15**B and **15**C). When the imaging cartridge **4** reaches the prescribed position in the apparatus body **1***a*, the shutters **42**A and **42**B reach the open position, by which the connecting section **41** of the cleaning device **24** and the waste toner box **26** is opened. Thus, in the case where the alternative shown in FIGS. **15**A to **15**C is adopted, the shutters **42**A and **42**B also move from the close position to the open position when the imaging cartridge **4** is in the process of being moved to the prescribed position in the apparatus body **1***a*, which makes it possible to ensure prevention of leakage and scattering of the toner from the connecting section **41** of the cleaning device **24** and the waste toner box **26** during loading and unloading of the imaging cartridge **4** to/from the apparatus body **1***a*. The pinion may be supported not by the waste toner box **26** but by the cleaning device **24**. The rack may be provided not in the shutter **42**B on the waste toner box **26** side but in the shutter **42**A on the cleaning device **24** side.

FIGS. **16**A to **16**C show another alternative drive mechanism for the shutters **42**A and **42**B which open and close the waste side toner delivery opening **24***b* and the waste side toner reception opening **26***a*. First, a driving gear **68** is supported rotatably around a Y axis on the apparatus body **1***a* side of the image forming apparatus **1**. The driving gear **68** is rotated by a power source such as a motor schematically shown by a reference numeral **69**. A nut section **70** is formed in the shutter **42**B on the waste toner box **26** side, and a feed screw **71** is screwed into the nut section **70**. A driven gear **72** is fixed to one end of the feed screw **71**. The driven gear **72** and the feed screw **71** rotate coaxially.

When the imaging cartridge **4** is in the process of being inserted into the apparatus body **1***a*, the driven gear **72** is not engaged with the driving gear **68** (FIG. **16**A). However, once the imaging cartridge **4** completes its movement to a prescribed position in the apparatus body **1***a*, the driven gear **72** is engaged with the driving gear **68**. In this state, the driving gear **68** is rotated by the power source **69**. Rotation of the driving gear **68** is transmitted to the driven gear **72**. The feed screw **71** rotates with the driven gear **72**, and the rotation of the feed screw **71** is converted into a linear motion of the nut section **70**. As a result, the shutters **42**A and **42**B move from the close position to the open position as shown by arrow "D". Thus, in the case where the alternative shown in FIGS. **16**A to **16**C is adopted, the shutters **42**A and **42**B move from the close position to the open position after the imaging cartridge **4** has moved to the prescribed position in the apparatus body **1***a*, which makes it possible to ensure prevention of leakage and scattering of the toner from the connecting section **41** of the cleaning device **24** and the waste toner box **26** during loading and unloading of the imaging cartridge **4** to/from the apparatus body **1***a*. The combination of the feed screw and the nut section may be provided not in the shutter **42**B on the waste toner box **26** but in the shutter **42**A on the cleaning device **24** side.

The present invention is not limited to the embodiments disclosed but includes various modifications. Although the present invention has been explained regarding the printer of the direct transfer type, the present invention can also be applied to image forming apparatuses of indirect transfer type in which a toner image is primarily transferred onto an intermediate transfer belt from respective imaging cartridges and the toner image on the intermediate transfer belt is secondarily transferred onto a recording medium. The present invention is also applicable to image forming apparatuses other than printers, such as copying machines, facsimile machines, and multi-functional machines.

Although the present invention has been fully described in conjunction with preferred embodiments thereof with reference to the accompanying drawings, various changes and modifications are possible for those skilled in the art. Therefore, such changes and modifications should be construed as included in the present invention unless they depart from the intention and scope of the invention as defined by the appended claims.

What is claimed is:

1. An imaging cartridge detachably loaded into an image forming apparatus body, comprising:

a process unit comprising at least an image bearing body, a developing device adapted to develop an electrostatic latent image on the image bearing body to form a toner image, and a cleaning device adapted to collect toner remaining on the image bearing body after transfer of the toner image;

a toner box unit integrally comprising a new toner box adapted to store unused toner to be fed to the developing device and a waste toner box adapted to store waste toner collected by the cleaning device, the toner box unit being detachably attached to the process unit;

a first shutter mechanism movable in a linear motion to a close position which blocks movement of the toner through a first connecting section between the new toner box and developing device and an open position which permits the movement of the toner through the first connecting section;

a second shutter mechanism movable to a close position which blocks movement of the toner through a second connecting section between the waste toner box and cleaning device and an open position which permits the movement of the toner through the second connecting section;

a first shutter drive mechanism adapted to enable the first shutter mechanism to be moved between the close position and open position by manual operation when the process unit with the toner box unit attached thereto is out of the image forming apparatus body; and

a second shutter drive mechanism adapted to move the second shutter mechanism from the close position to the open position during movement of the process unit with the toner box unit attached thereto to a predetermined position in the image forming apparatus or after completion of the movement to the predetermined position.

2. An imaging cartridge according to claim 1, wherein the first shutter mechanism comprises:

a new toner box side shutter provided in the new toner box and adapted to be movable in an opening and closing direction perpendicular to an attachment direction of the toner box unit to the process unit; and

a developing device side shutter provided in the developing device and adapted to be movable in the opening and closing direction,

wherein upon attachment of the toner box unit to the process unit, the new toner box side shutter and developing device side shutter are removably coupled to each other so as to be moved together in the opening and closing direction between the close position and open position.

3. An imaging cartridge according to claim 2, wherein the first shutter drive mechanism comprises a manual operation member coupled to the new toner box side shutter.

4. An imaging cartridge according to claim 3, wherein the first shutter drive mechanism further comprises:

a locking mechanism adapted to lock the manual operation member in a predetermined position when the toner box unit is in a state of being detached from the process unit; and

a lock release mechanism adapted to release the lock by the locking mechanism to allow the manual operation member to be moved when the toner box unit is attached to the process unit.

5. An imaging cartridge according to claim 1, wherein the second shutter mechanism comprises:

a waste toner box side shutter provided in the waste toner box and adapted to be movable in an opening and closing direction perpendicular to an attachment direction of the toner box unit to the process unit; and

a cleaning device side shutter provided in the cleaning device and adapted to be movable in the opening and closing direction,

wherein upon attachment of the toner box unit to the process unit, the waste toner box side shutter and cleaning device side shutter are removably coupled to each other so as to be moved together in the opening and closing direction between the close position and the open position.

6. An imaging cartridge according to claim 5, wherein the second shutter drive mechanism comprises:

a fixed cam section provided on the image forming apparatus body side; and

a cam follower section provided at least either in the waste toner box side shutter or the cleaning device side shutter, the cam follower section being pressed by the fixed cam section as the process unit with the toner box unit attached thereto is inserted into the image forming apparatus body so that the waste toner box side shutter and cleaning device side shutter are moved together toward the open position.

7. An imaging cartridge according to claim 5, wherein the second shutter drive mechanism comprises:

a first rack fixed to the image forming apparatus body side;

a pinion rotatably supported by the waste toner box or cleaning device; and

a second rack provided in the waste toner box side shutter or cleaning device side shutter and constantly engaged with the pinion.

8. An imaging cartridge according to claim 5, wherein the second shutter drive mechanism comprises:

a driving gear arranged on the image forming apparatus body side;

a feed screw screwed into a nut section provided in the waste toner box side shutter or cleaning device side shutter; and

a driven gear fixed to the feed screw so as to be rotated coaxially with the feed screw;

wherein upon completion of movement of the process cartridge with the toner box unit attached thereto to the predetermined position in the image forming apparatus, the driven gear is engaged with the driving gear, and the rotation transmitted from the driving gear to the driven gear is converted into a linear motion by the feed screw and the nut section, so that the waste toner box side shutter and cleaning device side shutter move.

9. An image forming apparatus, including the imaging cartridge according to claim 1.

10. An imaging cartridge detachably loaded into an image forming apparatus body, comprising:

a process unit comprising at least an image bearing body, a developing device adapted to develop an electrostatic latent image on the image bearing body to form a toner image, and a cleaning device adapted to collect toner remaining on the image bearing body after transfer of the toner image;

a toner box unit integrally comprising a new toner box adapted to store unused toner to be fed to the developing device and a waste toner box adapted to store waste toner collected by the cleaning device, the toner box unit being detachably attached to the process unit;

a first shutter mechanism movable to a close position which blocks movement of the toner through a first connecting section between the new toner box and developing device and an open position which permits the movement of the toner through the first connecting section;

a second shutter mechanism movable to a close position which blocks movement of the toner through a second connecting section between the waste toner box and cleaning device and an open position which permits the movement of the toner through the second connecting section;

a first shutter drive mechanism adapted to enable the first shutter mechanism to be moved between the close position and open position by manual operation when the process unit with the toner box unit attached thereto is out of the image forming apparatus body; and

a second shutter drive mechanism adapted to move the second shutter mechanism from the close position to the open position during movement of the process unit with the toner box unit attached thereto to a predetermined position in the image forming apparatus or after completion of the movement to the predetermined position,

wherein the second shutter mechanism comprises

a waste toner box side shutter provided in the waste toner box and adapted to be movable in an opening and closing direction perpendicular to an attachment direction of the toner box unit to the process unit, and

a cleaning device side shutter provided in the cleaning device and adapted to be movable in the opening and closing direction,

wherein upon attachment of the toner box unit to the process unit, the waste toner box side shutter and cleaning device side shutter are removably coupled to each other so as to be moved together in the opening and closing direction between the close position and the open position, and

wherein the second shutter drive mechanism comprises

a fixed cam section provided on the image forming apparatus body side, and

a cam follower section provided at least either in the waste toner box side shutter or the cleaning device side shutter, the cam follower section being pressed by the fixed cam section as the process unit with the toner box unit attached thereto is inserted into the image forming apparatus body so that the waste toner box side shutter and cleaning device side shutter are moved together toward the open position.

11. An imaging cartridge detachably loaded into an image forming apparatus body, comprising:

a process unit comprising at least an image bearing body, a developing device adapted to develop an electrostatic latent image on the image bearing body to form a toner image, and a cleaning device adapted to collect toner remaining on the image bearing body after transfer of the toner image;

a toner box unit integrally comprising a new toner box adapted to store unused toner to be fed to the developing device and a waste toner box adapted to store waste toner collected by the cleaning device, the toner box unit being detachably attached to the process unit;

a first shutter mechanism movable to a close position which blocks movement of the toner through a first connecting section between the new toner box and developing device and an open position which permits the movement of the toner through the first connecting section;

a second shutter mechanism movable to a close position which blocks movement of the toner through a second connecting section between the waste toner box and cleaning device and an open position which permits the movement of the toner through the second connecting section;

a first shutter drive mechanism adapted to enable the first shutter mechanism to be moved between the close position and open position by manual operation when the process unit with the toner box unit attached thereto is out of the image forming apparatus body; and

a second shutter drive mechanism adapted to move the second shutter mechanism from the close position to the open position during movement of the process unit with the toner box unit attached thereto to a predetermined position in the image forming apparatus or after completion of the movement to the predetermined position,

wherein the second shutter mechanism comprises

a waste toner box side shutter provided in the waste toner box and adapted to be movable in an opening and closing direction perpendicular to an attachment direction of the toner box unit to the process unit, and

a cleaning device side shutter provided in the cleaning device and adapted to be movable in the opening and closing direction,

wherein upon attachment of the toner box unit to the process unit, the waste toner box side shutter and cleaning device side shutter are removably coupled to each other so as to be moved together in the opening and closing direction between the close position and the open position, and

wherein the second shutter drive mechanism comprises

a first rack fixed to the image forming apparatus body side,

a pinion rotatably supported by the waste toner box or cleaning device, and

a second rack provided in the waste toner box side shutter or cleaning device side shutter and constantly engaged with the pinion.

12. An imaging cartridge detachably loaded into an image forming apparatus body, comprising:

a process unit comprising at least an image bearing body, a developing device adapted to develop an electrostatic latent image on the image bearing body to form a toner image, and a cleaning device adapted to collect toner remaining on the image bearing body after transfer of the toner image;

a toner box unit integrally comprising a new toner box adapted to store unused toner to be fed to the developing device and a waste toner box adapted to store waste toner collected by the cleaning device, the toner box unit being detachably attached to the process unit;

a first shutter mechanism movable to a close position which blocks movement of the toner through a first connecting section between the new toner box and developing device and an open position which permits the movement of the toner through the first connecting section;

a second shutter mechanism movable to a close position which blocks movement of the toner through a second connecting section between the waste toner box and cleaning device and an open position which permits the movement of the toner through the second connecting section;

a first shutter drive mechanism adapted to enable the first shutter mechanism to be moved between the close position and open position by manual operation when the process unit with the toner box unit attached thereto is out of the image forming apparatus body; and

a second shutter drive mechanism adapted to move the second shutter mechanism from the close position to the open position during movement of the process unit with the toner box unit attached thereto to a predetermined position in the image forming apparatus or after completion of the movement to the predetermined position,

wherein the second shutter mechanism comprises

a waste toner box side shutter provided in the waste toner box and adapted to be movable in an opening and closing direction perpendicular to an attachment direction of the toner box unit to the process unit, and

a cleaning device side shutter provided in the cleaning device and adapted to be movable in the opening and closing direction,

wherein upon attachment of the toner box unit to the process unit, the waste toner box side shutter and cleaning device side shutter are removably coupled to each other so as to be moved together in the opening and closing direction between the close position and the open position, and

wherein the second shutter drive mechanism comprises

a driving gear arranged on the image forming apparatus body side,

a feed screw screwed into a nut section provided in the waste toner box side shutter or cleaning device side shutter, and

a driven gear fixed to the feed screw so as to be rotated coaxially with the feed screw,

wherein upon completion of movement of the process cartridge with the toner box unit attached thereto to the predetermined position in the image forming apparatus, the driven gear is engaged with the driving gear, and the rotation transmitted from the driving gear to the driven gear is converted into a linear motion by the feed screw and the nut section, so that the waste toner box side shutter and cleaning device side shutter move.

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